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Applying the Premium Plan to a Pattern Shop

How One Large Foundry Offered Additional Financial Inducements to Its Patternmakers With a Marked Increase in Production and Decrease in Costs

By D M Avey

COMPENSATION is the motive power driving labor. The determination of the amount of this compensation in proportion to the service rendered is the point at which all discussion begins. Regulation of this proportion, the fixing of definite return for a measure of productive labor forms the basis for all systems of wage rates, bonuses, premiums and special incentives. The ideal condition exists when each workman returns his full capacity of work and receives remuneration directly proportional to his ability. The ideal is difficult of attainment, but may be closely approached as is evidenced by the satisfactory working of a premium system in force in the pattern shop of the Westinghouse Electric & Mfg. Co., Cleveland. Originally started in the Pittsburgh plant of this company, the premium plan has been refined and expanded through the efforts of George

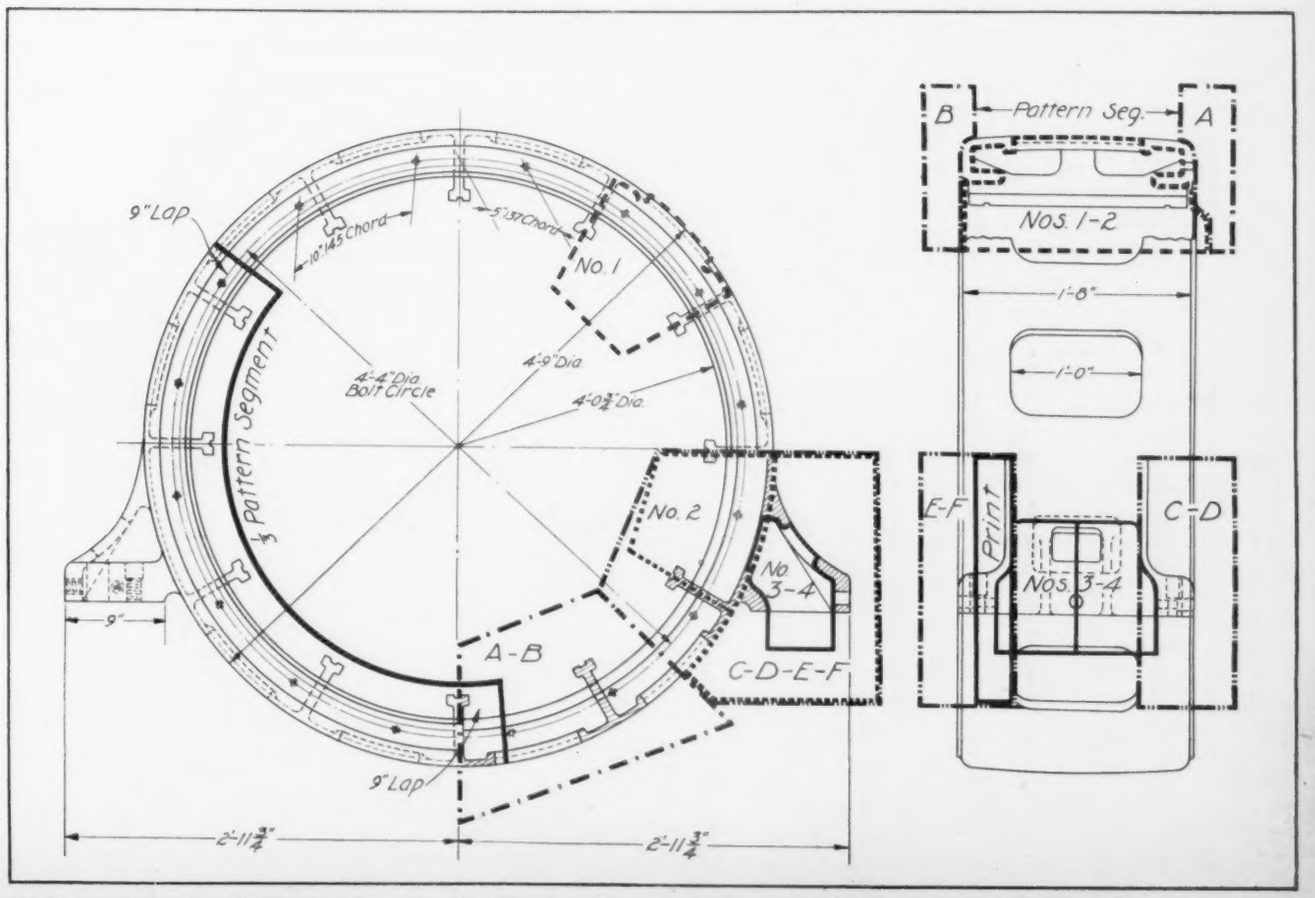


FIG. 1—DRAWING OF A MOTOR FRAME TO BE CAST—THE NECESSARY PATTERNS AND CORE BOXES ARE INDICATED BY THE BROKEN LINES—THIS ANALYSIS AND ANY SPECIFICATIONS AS TO MATERIALS TO BE USED ARE PENCILED ON THE BLUEPRINT IN THE PATTERN-SHOP OFFICE

COMPANY JOB ORDER No. 105448

Operation — Order No.

Pattern No. / Item No.	No. Pieces Completed	LIMIT EACH Hrs.	LIMIT EACH Min.	TOTAL LIMIT Hrs.	TOTAL LIMIT Min.	Limit No. / Dwg. No.

Check No.	Rate	Check No.	Rate	Check No.	Rate	Check No.	Rate	Check No.	Rate	Check No.	Rate
NAME		NAME		NAME		NAME		NAME		NAME	
Date	Hours	Date	Hours	Date	Hours	Date	Hours	Date	Hours	Date	Hours

Approved

Dept. ..... Foreman

This company reserves the right to at any time discharge employees working piece work under this contract or to terminate said contract at any time before its completion.

Form No 1006 Rev. 1 PREMIUM TO BE PAID ONLY WHEN WORK IS CORRECTLY DONE.

FIG. 2—COMPANY JOB ORDER OR CONTRACT UPON WHICH THE PATTERNMAKER RECORDS THE TIME CONSUMED ON EACH JOB

J. Geyser, foreman, and I. A. Rimmel, rate setter. C. F. Knowlton, superintendent, has fostered this development.

This system, applied in the entire pattern department, depends for its success upon the honesty with which it is operated. A time estimate, or limit, is placed upon each job which goes to each pattern bench. If the patternmaker meets the requirements, which will be later explained, he receives his compensation and premium based upon the speed and skill with which he constructs the job. The *limit* is *never lowered.* If he develops greater rapidity and through proficiency can cut down the time by one-half, the company does not take advantage of his improvement. The workman's compensation varies directly with his production.

All Parties Pleased

The success of the plan is attested equally by the administratives, the foremen and patternmakers. This universal agreement between all affected makes the system unique among the hundreds of plans which have been devised, applied, and failed or in some cases have been accepted with reservations. The executive officers are pleased with the greater volume of work turned out. The foremen approve the increased diligence and industry of the men, and the factor which permits a definite promise of time of delivery on each pattern. The men make more money, and appreciate the opportunity to improve their skill and their return. In fact it is stated that the abolishment of the premium system as now applied would be objected to strenuously by the patternmakers.

Obviously, the correct establishment of time required on each pattern is the factor of greatest importance in successfully carrying out this system. The *limit setter* has a large responsibility in the success of the premium system in operation at the Westinghouse plant. The foreman receives the drawing for each job, marks the patterns and cores needed and passes it to the limit setter. The latter's practical knowledge, ability, accuracy and experience all must bear a share in determining the reasonable time required on the patterns. He establishes the time limit under which the men work, and in consequence he must know that he is right in his estimate and must be able to sell this knowledge to the workmen. Honesty, and confidence in this honesty from the workmen, is invaluable.

When the system first was installed the work necessary to determine the time on each pattern was much more complicated than it is at present. The limit setter laid out the patterns on each drawing. Then mentally he went through each mechanical process necessary to make each part of each pattern. The auxiliary operations, throughout the entire program also had to be followed out mentally. The sum of the entire time estimated was noted on a slip attached to the drawing. The lack of precedents made the work much more difficult during the first few months that the plan was in operation. Now the limit setter has access to records which will be noted later, that give him a tangible basis upon which to establish his estimate of time. Furthermore, the constant attention to time study has developed in the limit setter, an almost uncanny ability to guess how long it will take to do a certain job.

Developing the Seventh Sense

It is this ever active time sense, as it may be called, which makes the work of the limit setter successful. Without proficiency in this one detail the premium system, as here followed, would be productive of dispute and discord. The ever-growing card record maintained affords not only a basis upon which to establish time for future jobs, but also provides a check upon the accuracy of the limit setter. The records shown on these cards in the Westinghouse foundry at Cleveland testify to the ability of the man behind the time schedules.

The plan, in its simplest analysis, pays the patternmakers for all the time which they themselves save. The limit setter computes and notes on a slip pinned to the blue print, his estimate of the

Frame

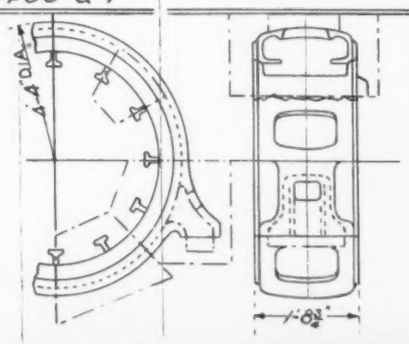
LIMIT	ACTUAL	RACK	SHELF
250	123½		

PATT No. — WOOD — MACHINE

CONJ. — METAL — PATT. PLATE

ORIG. — FLASKS

Patt. 365488-A-1 — CORE BOXES



Layout
⅓ Pattern Segment
6 Core A } 1 C.B.
6 " B }
1 " C-D-E-F-1 C.B.
10 " #1 }
2 " #2 } 1 C.B.
2 " #3 - 1 C.B.
2 " #4 - 1 C.B.
Gages

Form 4293-A

FIG. 3—FILE RECORD CARD FOR AID IN COMPILING THE LIMITS ON FUTURE JOBS OF SIMILAR CHARACTER AND CONSTRUCTION

time it will take to make all the patterns for a complete job. The pattern shop foreman checks this time carefully and in case of disagreement, it is discussed between them until a time is set upon which both concur. This time is then doubled. Twice the estimated time required is the limit set. Thus if the limit setter and the foreman agree that a job should take six hours, the limit set is 12 hours. If the workman completes the work under the time limit he is paid for 50 per cent of the amount of time he saves. If the job is completed in six hours, he receives three hours additional pay, added to his straight time. This fifty-fifty division has a psychological as well as a practical effect, as the workman realizes the partnership existing between himself and the company.

An additional 20 per cent of the time saved is allowed if the job is finished within one-half the time limit. Thus, if a job is figured to take 18 hours, the limit is 36 hours. If the work is completed just within the 18 hours figured, 18 hours is saved. To this is added an additional or extra premium of 20 per cent or 3.6 hours. This total is then split and 10.8 hours is added as the premium paid. If the time made is less than 25 per cent greater than the estimated time, an additional 10 per cent is added before the time is divided fifty-fifty with the company. For any amount of time required in excess of the estimated time and 25 per cent additional no *extra* premium is allowed. Thus, if on the 18-hour job with the 36-hour limit, the pattern were made in 24 hours, the premium paid would be only one-half of the difference between 36 and 24, or 6 hours.

Each workman has the opportunity to increase his pay on each job by rapid work. This is in effect an increase in his hourly rate, for the skilled man completes a job under schedule, and is at work on another, while one less accomplished is engaged on his original work. The shop, in consequence, presents an unusual condition. Each workman seeks the foreman the minute he completes a job in order that he may be at work on the next task. This militates to keep the foreman busy, providing work for the men. The additional incentive of the premium also brings to each workman an added ambition. He is not satisfied to complete his task leisurely in the manner to which he has been accustomed; to take his own time in finding another job and to nurse it along in the same manner. Rather, his greatest desire is to complete the pattern in the manner best calculated to pass the eye of the checker in the shortest possible time. Skill is the sole means to this end, and consequently the *one best way* is eagerly sought as a means to added pay.

The premium system is extended so that practically every employe in the pattern shop benefits. The apprentice boy is given a rating on his jobs, and draws his premiums if sufficiently diligent and skillful. A skilled pattern-maker is employed practically full time in instructing these apprentices. He also is a participant in premiums computed over the number of tasks completed. Even the pattern checker is compensated in an unusual manner.

Obviously, it would be unfair to pay the checker on the basis of the number of patterns he passes. He must check each job with care and thoroughness to insure that it has not been slighted in an effort to make time. To prevent any possibility of ill feeling on the part of the workmen when patterns are returned for additional work, the checker is made a partner in each job. In fact, he is paid a premium based on the average of the time saved on all the jobs which he checks. Thus the men feel that he is fair to them, and the checker realizes that any defective patterns will be charged to him if later found to be bad.

Four men are employed constantly in repairing patterns. The difficulty of adjusting their wages to the premium system will be appreciated. A hastily repaired pattern, slicked-over with varnish, is difficult to detect and a source of danger to molding operations. To obviate this, the men were pooled and a premium payment based upon the total of jobs completed was put in effect. Their average increase over the number completed under the straight time system was divided among them in such a manner that if additional speed were developed in the work, all shared in the benefits equally with the others.

The full details of the premium plan, as applied throughout the pattern shop, perhaps may best be explained by an example which may be followed through, step by step.

Consider the motor frame casting for which a drawing is reproduced in Fig 1. This is one of the most frequently made jobs at the Westinghouse foundry, and past performance is recorded in a number of cards which have been made. If the job were figured anew, however, the limit setter would analyze it and schedule his needed patterns and core boxes as shown.

The analysis would be divided into the following classifications:

Layout.
Pattern—one-third segment with 9-inch lap.

Patt. Title Form 1533-B

S. O.	Promised Date	Delay	Dwg. Sub.
Sec. Chgd.	Hel by	Shipped	Date Rec'd
Contract	Oper. No. Limit	Actual Time	Workman

MATERIAL					Remarks
Description	Size	Quantity	Price	Value	
Pine					
Pine					
Pine					Patt. Plate / Wood Plate / Mach. Plate / Made in Cores
Pine					Flat D. W. Labor
Mahogany					Premium
Birch					Total Labor
					I.F.E.
					Material
Metal					Factory Cost
Total Material Cost					

FIG. 4—FOREMAN'S COST RECORD CARD KEPT IN CONJUNCTION WITH THAT SHOWN IN FIG. 3

Corebox for making six cores, *A*, and six cores, *B*.
Corebox for making one core, *C-D-E-F*.
Corebox for 10 cores, No. 1 and two cores, No. 2.
Corebox for making two cores, No. 3.
Corebox for making two cores, No. 4.
Gages.

The time required for these 10 different jobs would be figured next. The limit setter's knowledge of the time required for each detail of this work is imperative, as will be noted from his method of time analysis. His steps in arriving at the time may briefly be noted as follows:

Time required for making layout complete is estimated at 5 hours.

The width of the pattern is 1 foot 6 inches. The segment will require 12 rows of 1¾-inch lumber and four sections will be needed in each row, making 48 separate pieces to get out of stock. Cutting the material will require 4 hours. Building the job will require 5 hours. Shaping the outside will

take 7 hours. Making the arms by which the pattern is supported against the spindle will require 4 hours. The foot piece to form the outer wall of the supporting brackets for the frame and to be attached while two of the three divisions are rammed will require 7 hours. The print pattern will take an additional 3 hours. The total estimated time on the pattern segment is 30 hours.

Dovetail Corebox No. 1 and No. 2

Framing the box will take 8 hours. The bottom board and back wall also will require 8 hours. The pieces which will form the cope and drag recesses will require 10 hours. The two foot pieces are complicated and will require 18 hours. The print piece will take 1 hour. The total for this job is 29 hours.

Foot Core Boxes for Core No. 3 and No. 4

The frame and bottom board will take 9 hours. All loose pieces will require another 9 hours. The total for this job is 18 hours.

Gages

One hour should be sufficient for the gages required for setting the cores is entered before the contract form is returned to the patternmaker. This time is obtained from his regular time slip and must agree with the pay slip which is kept by the office. If the assigned job is not completed at the time his regular pay falls due, the workman is paid his regular hourly rate and his premium carries over until the next pay.

One day before each pay a slip is handed to each man which contains his name and check number, his forthcoming regular hours' pay, the premium hours and overtime due to date. This enables him to check his contract and correct errors before his pay is ready.

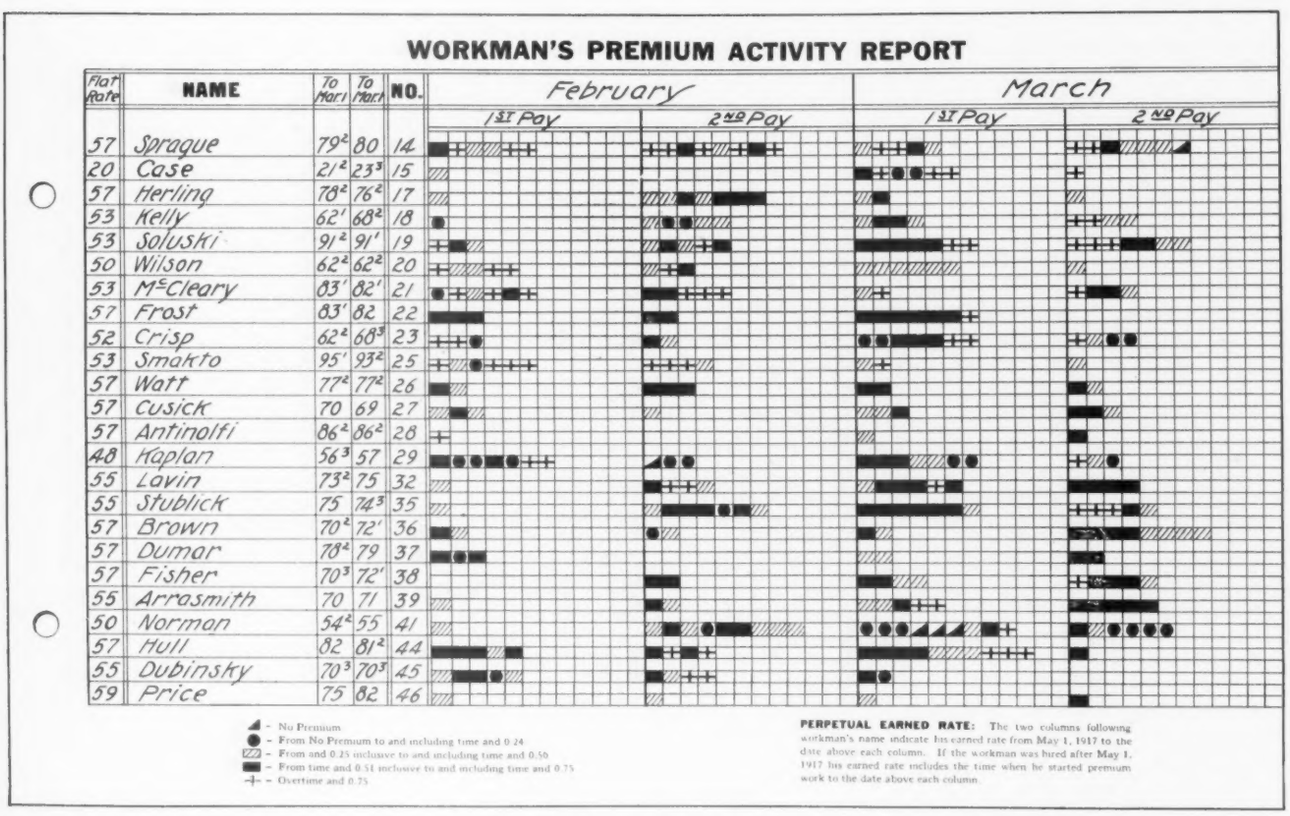

WORKMAN'S PREMIUM ACTIVITY REPORT
Flat Rate
NAME
To Mar 1
To Mar 15
NO.
February
March
1ST Pay
2ND Pay
1ST Pay
2ND Pay
57 Sprague 79² 80 14
20 Case 21² 23³ 15
57 Herling 78² 76² 17
53 Kelly 62' 68² 18
53 Soluski 91² 91' 19
50 Wilson 62² 62² 20
53 McCleary 83' 82' 21
57 Frost 83' 82 22
52 Crisp 62² 68³ 23
53 Smakto 95' 93² 25
57 Watt 77² 77² 26
57 Cusick 70 69 27
57 Antinolfi 86² 86² 28
48 Kaplan 56³ 57 29
55 Lavin 73² 75 32
55 Stublick 75 74³ 35
57 Brown 70² 72' 36
57 Dumar 78² 79 37
57 Fisher 70³ 72' 38
55 Arrasmith 70 71 39
50 Norman 54² 55 41
57 Hull 82 81² 44
55 Dubinsky 70³ 70³ 45
59 Price 75 82 46
- No Premium
- From No Premium to and including time and 0.24
- From and 0.25 inclusive to and including time and 0.50
- From time and 0.51 inclusive to and including time and 0.75
- Overtime and 0.75
PERPETUAL EARNED RATE: The two columns following workman's name indicate his earned rate from May 1, 1917 to the date above each column. If the workman was hired after May 1, 1917 his earned rate includes the time when he started premium work to the date above each column.

FIG. 5—WORKMAN'S PREMIUM ACTIVITY REPORT WHICH ACCURATELY AND GRAPHICALLY RATES EACH MAN'S PERFORMANCE—THE NAMES AND RATES PAID ARE ASSUMED, BUT THE RATIO OF INCREASE SECURED BY EACH MAN THROUGH THE SYSTEM ARE CORRECTLY NOTED

for the inner walls of metal shown in broken lines in the sectional view, will require 11 hours. The two one-half dovetail pieces to form the 12 posts inside the circumference shown in the plan drawing will take 8 hours. The stop-off for the cores, *A-B*, will require an hour. The total for the dovetail corebox is 36 hours.

Seat and Cover Core Box for Cores A and E

The frame and bottom board for this job will take 6 hours. The print piece will require 1 hour and the pattern piece an additional 3 hours. The total required for this job is 10 hours.

Foot Seat and Cover Core Box for Cores C-D-E and F

Making the frame and bottom board correctly on this work. A gage will be required only at the junction between the cores *A-B* and 1-2.

The total of the various increments of time estimated for the patterns and coreboxes for the entire frame is 129 hours. The limit setter allows an hour, and recommends that the limit on the job be made 260 hours. This recommendation is referred to the foreman, and if approved, a contract or company job order is drawn and the work is assigned. The form used is shown in Fig. 2. This job order or contract is held by the man to whom the job is assigned. He turns it in each morning when he comes to the shop and it is held by the foreman until quitting time. The time for each day in which he is working on a job

An essential feature of the premium system is the ability to refer to past performances. If a patternmaker questions the limit which is set, the system of records kept by the company enables the foreman to show him evidence that the job has been done within the limits asked. The record card form used is shown in Fig. 3. The sketch serves to give all the necessary information relative to the patterns and core boxes made. The limit and actual time is plainly set forth and on the reverse is more detailed data on similar jobs, with the records of results. This information is best described by repeating some of these notations from an actual card:

Pattern 366422-A-1. Limit 345 hours, actual 192 hours. Pine segment and

coreboxes. No dovetail coreboxes made.

Pattern 365068-A-2. Limit 285 hours. Actual 103¾ hours. Pine ¼-segment and pine coreboxes. Seven-foot, 7-inch outside diameter and 2-foot, 6¾-inch face. Refer to drawing.

In this manner the data necessary to make a comparison of the time required for the job under consideration and that which has been done is readily at hand. Any additional information, relative to the man who made the previous patterns and more specific and detailed differences in the jobs compared, may be had from the drawings and from the original contract slips which are filed. In this manner if a protest is registered against the time limit set, the sight of the record card on previous jobs, often challenges a spirit of competition in the man undertaking the new work. He sometimes voices this feeling in the statement that he can do as well as "that fellow did." The form shown in Fig. 4 is used by the pattern shop foreman in determining and recording the actual cost of every pattern which is made. As may be noted, it covers the material used, all information relative to the time employed and the rates paid, the overhead charge and the history of the pattern in its progress through the shop. The reverse of this card contains a detailed statement of the time consumed on the job.

The card forms made in applying this premium system would be valuable were they only used as records. However, the company has developed a most efficient means of interpretation and by allowing the employes free access to all this information, an impetus is imparted to the entire shop. The workman's premium activity report, which is reproduced in Fig. 5, shows the manner in which the standing of the men is visualized as effectively as the standing of the teams in a league.

This graphic record of the standing of the men is kept in the foreman's office, but is accessible at all times. The conventions used to indicate the rate on each job indicate at a glance the ability of the men to make their premiums. Each block indicates a job completed. The classifications range from that which indicates no premium earned to that which tells of a job upon which the workman earned time and 0.75. The graphic record and average amount per hour earned as compared to the flat hourly rate indicates the use of the chart. In the chart which is reproduced, the names and amounts paid are changed, but the proportion is maintained between the rates on the original record and that which is used. Thus the first man on the list, Sprague, No. 14, has increased his hourly rate during one month by 22½ cents an hour, or almost 50 per cent. During the next period his increase is 23 cents an hour. These facts are shown graphically in the chart. Similarly, the next workman, evidently an apprentice, has had a lesser number of premium jobs assigned, and has made only the time and 0.24 rate on two jobs which pulls down his average.

It has been established that workmen who were in some cases disinterested or at any rate only mildly active under the flat day rate system, have developed into experts under the premium plan. It has proved to be a keen spur to individual ambition.

The Two-Fold Benefit

New men in the plant have difficulty in appreciating how the system can make more money for them and at the same time benefit the company. It is true beyond doubt that the company gives each man an increase on all the time which he saves. How this operates conversely to the company's gain is the point which is often missed. A simple example will serve to make this clear. Consider a job, the estimated time on which is 30 hours, the limit is 60 hours, and for the purposes here taken the extra premium for completion below the limit is disregarded.

If the job is completed in 30 hours the workman receives 30 hours straight rate pay and an additional 15 hours, which constitutes his premium. Thus for 30 hours' work he receives pay for 45 hours, or an increase of 50 per cent for the time employed on this job. The pattern, of course, costs the company 45 hours' pay.

If the job is completed in 25 hours, the patternmaker receives 25 hours straight pay and an additional 17.5 hours or 42.5 hours. This is an increase of 70 per cent on his hourly rate. He gains 20 per cent per hour on this job. Conversely, the pattern costs the company less, as it pays for only 42.5 hours' work on the pattern.

The apparent paradox is difficult of explanation to the men until each has figured it out for himself; but when he has, he is invariably more than ever in favor of the premium system.

The definite advantages to the company are not all summed up in dollars and cents saved. It now is possible for the foreman of the patternshop to speak with assurance when he promises a job to the foundry on a certain day. He knows the job, the time it will take, and above all, he knows that the men will be as anxious as he to see it completed on time. It now is easier to figure a piece of work for which no repeat orders are contemplated. In this case, the cost of the pattern will be borne by the single casting to be made. The foreman can estimate in advance the price which should be bid on his part of the work. The certainty carried in all projected work, alone, would make the plan invaluable to the management.

A comparison shows that previous to the installation of the system the average day's work in the pattern shop was 188 jobs per day with 85 men. Taking an average over a comparative period at present, it now is possible to turn out 266 jobs with 62 men. The increase of 78 jobs completed with 23 less men would seem to be a favorable argument from the standpoint of the management alone. The reduction of the payroll by one-sixth is undoubtedly welcome. But with a realization of the increase which these 62 men find possible, the betterment of their work, and above all the increased production, the greatest value accrues to the patternmaker himself. Increased production alone is the measure of progress.

How to Cool Castings to Prevent Distortion

By M H Potter

IT is not an unusual occurrence, that castings which have been molded and poured correctly, are found to be warped and distorted when removed from the sand. This may be due either to improper design or to improper treatment of the casting before it is shaken-out. If a heavy part of the casting adjoins a lighter section, the latter will solidify first and the heavy portion, cooling later, will shrink and tend to draw away from the lighter part. If the casting does not rupture in this operation, strains may be set up which will warp it. This may be avoided by uncovering the heavier part of the casting to facilitate cooling, while the cooling of the lighter portion is retarded and the entire casting solidifies at about the same time. Shrinkage strains are avoided and the casting is removed from the sand true to pattern. The cooling of the light sections also may be retarded by covering them deeply with sand while

the heavier parts are exposed to the air.

How a casting will become distorted if allowed to cool normally may be foretold frequently from the shape of the pattern. This distortion may be avoided and the effects of unequal cooling counteracted by bending the pattern in the opposite direction an amount equal to its distortion if allowed to cool normally. When casting columns, the pattern is made with the ends relatively lower than the center portion. The mold is made with the middle of the column higher than the ends which cool last. The ends are drawn up as the casting cools and if the pattern has been cambered the right amount, the column will be straight when cool.

The same method is followed in casting the copings for the tops of brick walls and cornice work for buildings. The castings usually are provided with lips on the edges for bolting them together and are combined with moldings. The lips on the edges of the plates often are on opposite sides and the pattern is arranged on the mold-board curved in the opposite direction from which it will warp when cooling. Thus, one edge of the pattern will be cambered in one direction and the other in the opposite direction, and when the casting is cold these edges will be straight and parallel. Lathe bed patterns up to 14 feet in length, are cambered as the ends tend to rise when cooling. A lathe bed 30 feet long, however, is so heavy that the casting, in shrinking, will not lift the ends. Therefore, a bed of this size is cast with the center down.

Removing Sand Prevents Distortion

Many castings of different lengths must be kept covered on the ends during cooling, while the sand is dug away from them at the center. If a casting is of such size and shape that it must be left over night in the sand, it is advisable frequently to dig the sand away from the gates. This permits the casting to shrink without being held by the gates, thereby preventing rupture.

On certain classes of work it is not sufficient to retard the cooling of the thin parts, but an artificial supply of heat must be provided. The casting for a disk crank of a stationary engine is in this class. It consists of an engine crank surrounded by a web, the crank and counterbalance being concealed by a plate. This casting is molded with the plate face down and the pockets of sand to form the crank and counterbalance are lifted out into the cope. After pouring, the cope is lifted as soon as possible and the sand is dug out of these pockets, leaving only enough sand in them to protect the casting. Molten iron is then poured into these pockets and is covered with sand, after which the cores in the hub and crank-pin hole are dug out. By this method the thinner portions are continuously supplied with heat until the entire casting has cooled uniformly. If this precaution is not taken, the crank disk either will be cracked when it is taken from the sand or strains will be set up which will cause the disk to fail when it is forced on the engine shaft

Gating U-Shaped Castings

Castings of U-shaped section should be gated together at the top, since the tendency, in cooling, is for the bow to cool first and thus draw the legs of the casting apart; this is resisted by the gates which cool first. If it is impossible to gate the casting in this manner, the bow portion should be uncovered at the earliest possible moment while the legs of the U should be kept covered and their cooling retarded.

Pulleys for power transmission, with thin rims, should have the center core removed as soon as the metal has set, especially if the pulley is of large diameter. Often a pulley that is required in a hurry is removed from the sand while the hub is still red hot. This will cause a heavy strain on the arms and frequently will pull them from the rim. To obviate this, the sand should be dug away from the cope over the hub, as soon as possible. On the other hand, the rim and arms are kept covered and the heat is retained in them to retard cooling. Large flywheels and balance-wheels often are cast with the hubs split by cores, the rims being cast solid. As the rims contract, the two parts of the hub are forced together and the cracking of the arms and rims is avoided. Conversely, if the rim is heavy and the center comparatively light, the rim must be uncovered and cooled more rapidly than the center.

Plates cool first at the edges and frequently are checked. This can be prevented by removing the cope as soon as the casting has solidified and by knocking the sand from the cope on to the casting; channels are cut into the sand diagonally across the plate from opposite corners, thus permitting the center to cool in advance of the edges.

Castings having heavy, rigid cores may be ruptured by shrinking on to these cores. Thus, jacketed cylinders having light jacket walls and heavy barrels must have the cores removed promptly to prevent the barrels from cracking away from the jacket. Cored cylinders frequently have internal strains, set up by shrinking on the cores, and when the first roughing cut is made on them in the machine shop these strains are relieved and warp the casting. However, this defect may be remedied by annealing.

If a circle of iron of one thickness has another circle of greater thickness cast inside, there is considerable danger of cracking owing to the thicker circle cooling first and pulling away from the lighter outside section. To offset this tendency, some ingenuity is required. Usually, one particular spot in a casting of this character always causes trouble and, in a certain cast, this was obviated by placing a chill at a heavy part.

In loam molds, provision for shrinkage is made by inserting loam bricks in the mold, which are crushed by the contraction of the metal. Iron plates also are inserted in loam molds, which can be pulled out as soon as the casting is poured and thus provide ample space in which the metal may shrink.

After a casting has been removed from the sand, care must be exercised in its treatment until it has cooled down to atmospheric temperature. A large casting which may be exposed to a chilling draft on one side, such as might come from a door communicating with the outdoors in the winter time, would cool more rapidly on that side than on the other and thus crack just as surely as it would in the mold had no provision been made for crushing the cores.

Iron Mixture a Factor

The composition of the iron of which the casting is composed also has an influence on its treatment after pouring. Light castings for machine parts usually are removed from the sand immediately after the mold is poured. These castings are high in silicon and low in sulphur, manganese and combined carbon. A coating of sand frequently adheres to such castings in proportion to the thickness, protecting them from the air. However, if air does come in contact with the casting, the high silicon and the high graphitic carbon content prevent the formation of a hard scale. On the other hand, if the sulphur and manganese contents are high, the reverse will be true and a hard scale will form on the castings if the air is permitted to strike them before they have cooled to atmospheric temperature. Therefore, it is advisable to leave them in the sand until they have cooled, especially if they are to be machined. If it is necessary to remove them from the sand immediately after casting, they should be poured with iron of a silicon content about 20 points higher than ordinary.

An Oxidized Case Prevents Growth in Gray Iron

Internal Oxidation Which Results in the Expansion of Gray Cast Iron Through Repeated Heating is Investigated With Valuable Results

By J E Hurst

GROWTH or expansion of gray cast iron when subjected to repeated heatings in an oxidizing atmosphere has been shown to be due to the increase in volume resulting from the internal oxidation of the various constituents through the gradual penetration of the oxidizing gases into the center of the gray cast iron mass. It also has been shown that the whole of the constituent silicon is rapidly and completely oxidized, and the total growth experienced is roughly proportional to the extent of silicon present in the original iron.

The primary cause of growth is the presence of the free graphite plates which allow the entry and penetration of the oxidizing gases into the interior of the iron. It has been experimentally shown that in those white cast irons in which free graphite is absent, the total expansion is almost negligible, and for the most part can be accounted for by the precipitation of free carbon in the nodular annealing carbon form.

Malleable cast irons in which the free carbon exists in the nodular form of annealing carbon do not grow. This is the result of the fact that the graphite in these irons does not present a continuous path for the penetration of the oxidizing gases into the interior of the mass.

It therefore readily will be appreciated that any method whereby the entrance of the oxidizing gases into the interior of the casting is prevented will simultaneously prevent growth. Methods in which the outside surface of the material is coated with a layer of impervious refractory enamel suggest themselves as a means whereby the entry of the oxidizing gases may be prevented. Apart from the difficulty of obtaining a suitable enamel, such methods would entail many disadvantages.

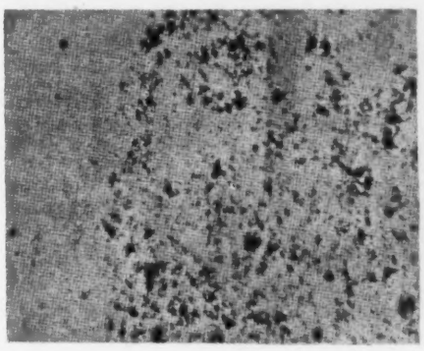
The removal of the free graphite from the exterior surface layers of the cast iron would appear to be an ideal method for preventing the penetration of the oxidizing gases. Such a method would amount to the production of a skin or *case* of decarbonized material around the cast iron which effectively would prevent the entry of the oxidizing gases, and the use of alternative white irons which involve difficulties in machining

An example has been recorded in the shape of a length of gray cast iron water pipe, 4 inches in diameter and about $\frac{1}{8}$ inch in thickness, which was prevented from growing by the formation of a protecting *case*. The pipes were repeatedly maintained at a temperature in the region of 800 degrees Cent. and 900 degrees Cent. alternately for a considerable period in a strongly oxidizing furnace atmosphere. The chemical composition of the cast iron was as follows:

	Per cent
Combined carbon	nil
Total carbon, by combustion	2.20
Graphite	2.20
Silicon	2.66
Manganese	0.46
Sulphur	0.096
Phosphorus	0.95

This analysis was taken from the material after exposure to the heat, the low total carbon content being due to the unavoidable inclusion of drillings from the decarbonized portion of the iron. It was found on examination of the silica precipitate that the whole was quite white and flocculent. This confirms the absence of internal oxidation.

On fracturing the iron, the inner core of gray graphitic iron, surrounded on both sides by a case having a bright steely fracture, was rendered plainly visible. Photomicrographs taken from a section cut from this pipe are illustrated in Figs. 1 and 2. Fig. 1 shows the unetched sample. The completeness of the decarburization and the almost entire removal of the graphite plates are clearly shown. In Fig. 2, small traces of nodular areas, consisting possibly of carbon in the annealing carbon form, are revealed in the case. It is extremely interesting and important to note the existence of the phosphide eutectic constituent in the decarbonized case. This constituent was evenly distributed throughout the original material. In the interior of the heat-treated specimen the graphite appeared to exist in a finely divided, possibly annealing carbon form. The presence of holes was also noted, as would be expected as a consequence of the removal of a portion of the phosphide constituent. Many of the larger black areas in the interior were apparently filled with finely divided carbon. There is no doubt that the



<Core Case>

FIG. 1—DECARBONIZED SURFACE OF GRAY CAST IRON PIPE HEATED TO 900 DEGREES CENT.—UNETCHED SAMPLE
(MAGNIFICATION, 75 DIAMETERS)

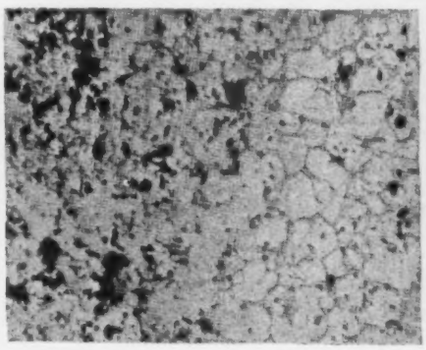


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FIG. 2—DECARBONIZED SURFACE OF GRAY CAST IRON, ETCHED WITH 1 PER CENT SOLUTION OF NITRIC ACID
(MAGNIFICATION, 100 DIAMETERS)

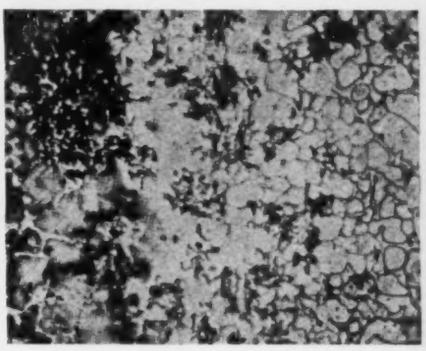

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FIG. 3—DECARBONIZED SURFACE OF GRAY CAST IRON, ETCHED FOR 45 SECONDS WITH CUPRIC CHLORIDE REAGENT
(MAGNIFICATION, 100 DIAMETERS)

Abstracted from a paper presented at a recent meeting of the Iron and Steel Institute of Great Britain.

heat-treated sample was somewhat more brittle than the normal metal; but in spite of this, it is important to note that the heat-treated iron possessed none of the *rottenness* associated with *grown* irons.

Previous to exposure to heat these pipes were heavily coated with a thick scale of rust (hydrated ferric oxide). It is considered that the initial presence of this scale has largely contributed to the decarbonization. In his repeat experiments the author met with success by prolonged annealing in this material.

The possibility of the complete removal of the graphite plates and the absence of spaces where the graphite originally existed when heat-treated under oxidizing conditions is clearly proved by the photomicrographs.

The possible methods by which graphite might be removed without the subsequent production of cavities in the metal are briefly summarized as follows:

Superficial decarburization and the oxidation of the graphite followed by the liquidation of the phosphide eutectic into the remaining cavities.

At temperatures of over 900 degrees Cent. within the range of temperature to which the foregoing samples have been exposed (900 degress Cent. to 1000 degrees Cent.) it is certain that a considerable portion of the graphite is redissolved, forming the austenite solid solution. In those irons containing considerable quantities of phosphorus the conditions are considerably more complex, but there is every probability of the resolution of the graphite taking place with the production of complex ternary constituents. Under these circumstances the possibility of the removal of the graphite with the entire absence of holes will be appreciated.

Further investigation is necessary before a complete explanation of the mechanism of the surface decarburization can be satisfactorily given. It appears extremely probable in this particular case that decarburization of the superficial layers of the austenite in direct contact with the heavy scale of ferric oxide primarily takes place. The austenite solid solution, in addition to the carbon originally existing as combined carbon, possibly contains some of the graphite dissolved, and in this manner the graphite is removed from a superficial layer and the entry of the oxidizing gases prevented.

The original analyses of the specimens used are not known, but it is legitimate to assume that the original carbon contents of this class of casting would be as follows:

Total carbon	3.25
Graphite	2.75
Combined carbon	0.50

Carbon is Oxidized

It will be noted, therefore, that about 1 per cent of the total carbon is removed by oxidation, and this is probably all removed at the high temperature, while in the austenite condition, by the gradual diffusion of the austenite toward the decarbonized portions. This assumption is borne out by heat-treatment experiments on a similar class of iron, in which it has been shown that when quenched from a temperature of 900 degrees Cent. to 950 degrees Cent., over 1 per cent of carbon can be retained in the dissolved austenite form. The presence of carbon in the annealing carbon form noticed in the core of the specimen is also additional proof of the fact that the graphite has been redissolved and reprecipitated in this form on slow cooling.

It is of importance to note the diffusion of the phosphorus in this particular sample. Fig. 3 shows a similar specimen to that mentioned, etched with Stead's cupric chloride reagent. As will be seen from the photograph, the whole of the decarbonized case is entirely unaffected by the reagent, showing that, in addition to the binary eutectic, a considerable amount of the phosphorus of the sample exists in solid solution in the decarbonized case.

It is considered in this particular instance that the diffusion of the phosphide is for the most part a secondary phenomenon. The phosphide will commence to dissolve as the concentration of the austenite solid solution is gradually reduced, and, as has been shown, the dissolved phosphide will tend to diffuse to the decarbonized portions along the outside edges and will tend to become concentrated in those portions.

It will be appreciated that the production of a decarbonized case around cast iron articles in this manner will be of considerable service in the prevention of growth under many circumstances. It has already been suggested that this method should find application in the protection from growth of dies and permanent molds for iron and nonferrous metals. Other important uses suggest themselves, such as the protection of valve seatings and valve guides in internal combustion engines. For this purpose further experimental work will be necessary to determine accurately the conditions under which this graphite best can be removed. Several permanent molds were prepared which were protected in this manner by annealing at a temperature of 900 degrees Cent. to 950 degrees Cent. in ordinary brown rust for a period of 72 hours. The results also were considerably improved by raising the annealing temperature to 975 degrees Cent. to 1000 degrees Cent. Troubles, however, were experienced in these cases through distortion. At this high temperature the removal of the graphite appears to be brought about through the formation of the ternary eutectic of iron, phosphorus, and carbon.

A Successful Accident Prevention Campaign

By F J Bennett

THE plant that is being discussed is located in Ohio and consists of a foundry building, 1200 feet long, with side floor leantos for molding machines. In direct connection with this building is the cleaning department running at right angles from the main foundry building. Seven 25-ton open-hearth furnaces and one 8-ton electric furnace comprise the melting equipment. Forty overhead cranes are used. There are separate buildings for pattern, mechanical, carpenter, core and other necessary departments in addition to the buildings just named. The maximum working force is 2200 employes and the average force is 1600. The nationality of the employes is divided as follows: White Americans, 50 per cent; negroes, 35 per cent and white foreigners, 15 per cent.

During 1917 our accident experience was what might be termed bad, and during the latter part of that year we decided to intensify our accident prevention work and inaugurate a safety committee organization. On Jan. 1, 1918, safety committees were appointed in each department consisting of from one to three members each. A definite schedule was drawn up for their meetings and activities. A meeting of all committees for each turn is held every two weeks and on the last Friday of each month a general meeting of all committees from both turns together with the foremen is held in the latter part of the after-

Presented before the Milwaukee convention of the American Foundrymen's association.

noon, when an outside speaker addresses the meeting. These committees are appointed for a term of three months and are now selected from employes promiscuously. In the beginning of this work we appointed subforemen and older employes on the committees, but have now decided that the best and most effective safety committee is selected from employes of all classes. We think it well to appoint new employes on safety committees as it instills in them a spirit of activity shortly after they are employed.

How Committee Members Are Appointed

All newly appointed members of safety committees are notified by a personal letter from the general superintendent and are each presented with a safety watch fob with an inscription reading, "Help Prevent Accidents Every Day." The natural query comes from almost all of the newly appointed committeemen as to what they are to do. We impress upon them that above all things they should spread a propaganda of carefulness among their fellow workmen. They are also instructed to carry on systematic inspections and report their findings accordingly.

We anticipated no noticeable effect from this committee plan for a few months, but were agreeably surprised to see a remarkable and abrupt reduction in accidents after Jan. 1, 1918. The monthly average number of lost-time accidents during the year of 1917 was 62 and during the first six months of 1918 this was reduced to 26. This is a graphic testimonial of what safety committee work has done in our plant. During the first six months of 1917, 32,170 working hours were lost on account of accident absentees and during the first six months of 1918 this was reduced to 17,478 working hours. This latter figure is the real economic basis of this work.

There are other important standards that must be adopted and lived up to, to bring about successful accident prevention results. First, the management must be 100 per cent back of the movement. No movement of this nature can be successful unless the employes are thoroughly convinced that the company is behind them to the limit. This will lead up to the second important standard which is the enthusiastic spirit of the foremen throughout the plant. Without these two important factors no safety committee organization will succeed. Publicity through bulletin boards and shop magazines relating stories of accidents and their prevention is a necessary feature. We have also found that an occasional talk by the highest executive in the organization to the safety committees and foremen is wonderfully beneficial. In all meetings we consider it very important that some official of the company be present even though he only takes part in the discussion, as his presence indicates an interest on the part of the company. For example, at one of our meetings the president of the company was present sitting among the workmen and being no more than a listener.

As to our opinion of safety commitee work, we can only say that we have stated it and it is now on a thoroughly working basis and the results we are obtaining far exceed our expectations. We have no thought of discontinuing safety committee work as we feel that it is sound enough to be a part of our operating organization. There have been some mistakes made in safety committee work on the part of executives who thought that these committees can only be composed of subforemen or employes long in the service, feeling that after having included all of these persons on safety committees the work has been accomplished. Our feeling is that the work has just been started and that the new employe must be recognized in activity of this nature. We do feel, however, that it is well to form a committee with at least one of the older employes as a member.

There has been nothing mentioned in this paper concerning the installation of mechanical safeguards as it was the purpose of the author to confine this discussion to the larger group of accidents from the lack of thought on the part of the employes. We can see no other means of attacking this large group of accidents than by systematic safety committee organization. We are convinced from our own experience that it is paying.

Plans to Re-establish Foundry in Palestine

At an early date, one American manufacturer who has pioneered in the Orient, plans to re-establish his business. Several years before the war, Harry Kaplan, 502 Swetland building, Cleveland, built a gray iron foundry and machine shop in Jaffa, the historic seaport of Jerusalem, in Palestine. For a year after hostilities had started, this plant was operated on a restricted basis, but at the end of that period the Turkish occupation forced Mr. Kaplan to become a refugee. Later, when the British took Jaffa, they found that the Turks had not destroyed the shop and that it was available for necessary machine and ordnance repair and munition work. The plant now has been returned to its owners and Mr. Kaplan plans to leave within the next month to make needed repairs and additions preparatory to resuming operations.

The plant was built primarily to furnish repairs for machinery which was imported. Slow communication facilities make it imperative that exporters who wish to enter this portion of the world's market shall be able to furnish replacement parts. A large stock of materials is impractical, so that a universal metal-working shop must be supplied to care for this need.

Mr. Kaplan in his previous experience found American exporters slow to take advantage of this market. In some cases they availed themselves of established German agencies with the result that German made machinery was installed at the expense of that made in America.

The factory at Jaffa, in addition to general repair work, engaged in the manufacture of presses and olive oil machinery, flour mills and pumps. It is the present intention of the management to buy additional machinery and equipment for both the foundry and machine shop and to arrange connections, if possible, with American exporters for pig iron and other raw materials.

Industrial Chemical Service Co. Organized

The Industrial Chemical Service Co., 185 Madison avenue, New York, has been organized by Dr. Maurice Aisen and Walter F. Dumser. An extensive laboratory is now being equipped near New York for the technical study of manufacturing problems. Dr. Aisen, who is vice president and technical director of the company, is a research and industrial chemist with an European education and over 10 years' American experience. Mr. Dumser, who is commercially trained, is president of the new company. The Industrial Chemical Service Co. expects to specialize on problems connected with the development of nonferrous alloys, coke oven by-products, nitrogen fixation, and kindred lines. The company aims to develop new processes from the laboratory to the manufacturing stage, and for this purpose, complete equipment will be provided, together with a staff of engineers, chemists, accountants, etc.

James A. Butler and F. Albert Hayes have organized the firm of Butler & Hayes, Inc., mechanical and chemical consultants and experimental engineers, with headquarters at 220 Devonshire street, Boston.

Paving the Way for the Guns

WHEN Foch delivered one of the rapier-like thrusts which characterized his *articulated* rolling back of the German lines, artillery concentration was the essence of success. When a well executed attack won the objective, however far flung, the artillery was in advanced position ready to repulse the enemy counter-effort. Captured German guns were quickly hauled to a point of safety from pursuit. All this carefully conceived sequence which spelled final defeat for the Hun, was possible through the one factor—mobility. The caterpillar artillery tractor, a modified American farm power unit made this mobility possible.

When Benjamin Holt invented his engine which lays its own track, he designed for peaceful pursuits. The ability of this machine to pull, to climb and to negotiate soft soil recommended it as the twentieth century war steed. Its use in the artillery branches of the armies of Europe has been noted since the early days of the war. The caterpillar pulled artillery early in the conflict and through its performance inspired the tank, the greatest single factor in breaking the iron ring about central Europe.

Foundries Laid the Track

Midwestern foundries in the closing weeks of the war were engaged in paving the way for American avalanche of artillery. Over 25,000 caterpillar tractors were under order or had been completed and shipped abroad. These included five classes, rated on pulling power at 2½, 5, 10, 15 and 20 tons.

Foundries were supplying in increasing quantity the great number of castings required by this program. The principle of the caterpillar tractor is by this time well known. An endless belt on each side of the machine rolls over two pulleys. The rear pulley is in fact a sprocket, connected through drive chains and clutches to the motor. The front pulley is a sheave, serving merely to guide the belt in its path. This continuous belt, in effect is a track, laid down in front by the sheave. The machine supported on a series of steel rollers, travels forward as the rear sprocket engages recesses in the belt. The inner surfaces of the belt shoes form a track. This track is picked up behind and carried forward to repeat the sequence. Numerous castings enter into the construction of the machine. The two pulleys, cross frames, called equalizers, track links, grousers and other component parts are cast steel.

The track links or shoes and grousers by reason of the great number required are of more than passing interest as a

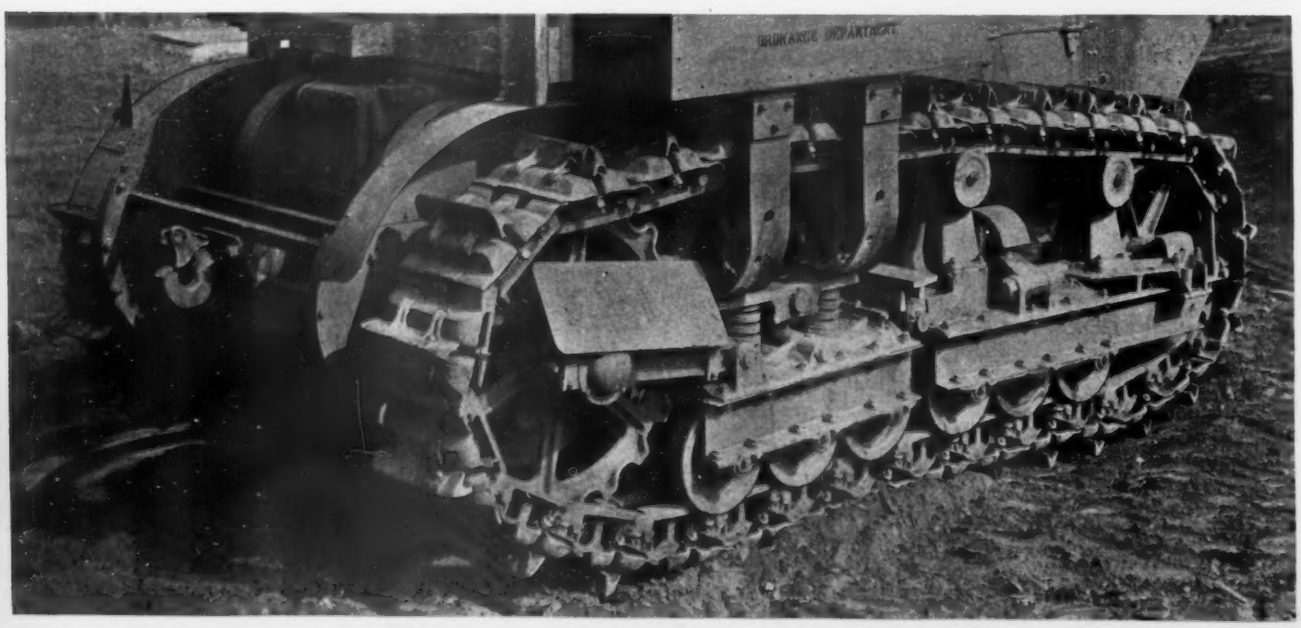


FIG. 1—THE BUSINESS END OF THE MODERN ARTILLERY MULE—NOTE THE MANNER IN WHICH THE SEPARATE LINKS OR SHOES FORM A TRACKWAY FOR THE SUPPORT ROLLERS, AND HOW THE GROUSERS ARE ATTACHED

foundry problem. The grousers, it may be stated, are merely mud hooks, which are securely clamped to the links to enable the tractor to *dig in his toes* in soft going. The track shoes, or links, and grousers with their connecting bolts are shown in Fig. 1.

In the tractor program, the 2½, 5, and 10-ton sizes made up more than three-fifths of the number needed. Each of these types required from 58 to 86 shoes to each machine in the initial assembly. The tremendous wear encountered over the macadam roads, rocks, shell holes, and timber-scarred lands of France made necessary a large percentage of shoes for replacement. The ordnance department's estimate of 25 per cent was superseded by a 50 per cent requirement for replacement on request of General Pershing. The quantity of shoes needed perhaps may be better realized from the numbers ordered. One request for bids called for 118,000 of a 28-pound shoe alone.

Manufacturing these shoes called for enormous foundry capacity. In the vicinity of Peoria, where the Holt Mfg. Co. was assembling artillery tractors, and in the territories adjacent to the Reo Motor Car Co., Lansing, Mich., the Chandler Motor Car Co., Cleveland, and numerous other assembling plants, foundries were called upon to furnish a great number of these links or shoes.

Quantity production was the paramount necessity. Under stable conditions this would have involved merely an increased working force, with perhaps extensions to molding and melting capacity. Confronted by labor shortage, however, foundrymen met a more complicated problem. The case of the Zimmerman Steel Co., Bettendorf, Ia., is typical of many. Prior to the war period, this company made steel castings for a wide range of commercial requirements. The war brought an increase in demand for locomotive frames and miscellaneous railroad castings, which assured continuous operation. Contracts for track links and grousers were to be had for the asking, and undoubtedly this foundry was given the opportunity to handle some of the requirements of the government in this line. Certain conditions, however, made this class of work unattractive to a foundry already at capacity production. Rigid specifications required a given weight in the finished shoe, a provision difficult to attain in a thin steel casting with webs and flanges which might induce an overage or shortage. It may be said to the credit of the ordnance department, however, that sensible inspection often waived this clause and finally it was eliminated.

As the need for the track links became more urgent, the Zimmerman plant was prevailed upon to enter the field. The problem was attacked in the light of years of experience with small and medium foundry work. Obviously, under the then prevailing labor conditions, augmented by government competition at the Rock Island arsenal nearby and numerous plants in Davenport, Rock Island and Moline, a wide expansion of human molding effort was impossible. Machine-molding was the solution.

A machine designed and built by the Davenport Machine & Foundry Co., practically at its doors, was chosen by the Zimmerman plant to handle its work. This machine only recently has been designed and it embodies unique principles which may well be described. Figs. 4, 5 and 6 illustrate its principles and operation. The machine is a full combination power-jolt, rollover and mold-drop type. The units are integral and are mounted on a common base, which of course is not visible in the illustrations. A positively-actuated valve imparts a full table jolt to the mold which rests upon the rollover arm, the pattern board being firmly bolted to the latter. The power rollover is effected through an air cylinder which is attached to the steel rollover arms. Sufficient power is provided to swing the arms, bottom-board, flask sand and pattern through an angle greater than 90 degrees and to hold it in the position shown in Fig. 6. The rollover power cylinder is pivoted at its lower end to a transverse shaft between the two standards as may be noted at *A*, in Fig. 4.

The mold-drawing mechanism possesses novel points of design. The flask rest is mounted on a draw cylinder traveling in oil and rigidly guided. Telescoped in the draw cylinder is an adjusting cylinder which serves to conform the flask rest to various depths of flasks within the fraction of an inch, after which equalizers, shown at *B*, Fig. 5, provide for any surface irregularity in the bottom board under the mold. These equalizers, in effect, are short columns with the bottoms beveled to a wedge shape. The operation of the hand lever, shown plainly at *C*, Fig. 4, brings four sliding wedges to bear against the slope of the wedge columns, raising the columns until their heads have a firm bearing against the bottom board of the flask. The raising wedges are all directed by the one hand lever and are linked together in such a manner that when one column is brought to bear against the bottom board, it comes to rest and the force is applied against the other columns successively until all

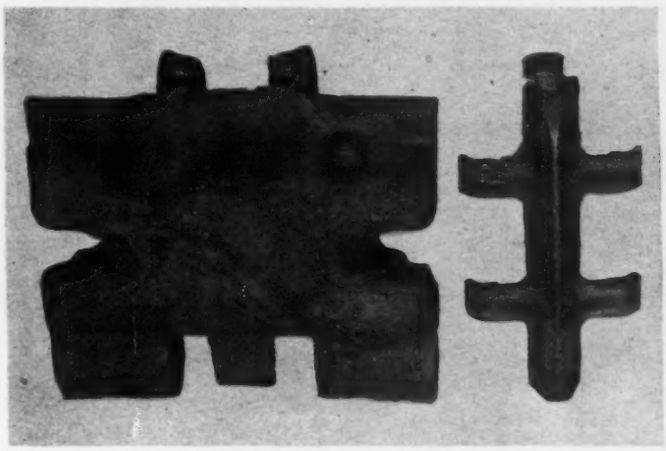


FIG. 2—TRACK LINKS WERE REQUIRED TO MEET MEASUREMENTS WITHIN A NARROW MARGIN, PARTICULARLY IN THE GROUSER SLOTS—THE GROUSERS WERE CAST WITH ONE LUG ONLY—A HINGED BOLT WITH AN END NUT FITS INTO THE OPPOSITE SLOT IN THE TRACK LINK TO HOLD THE GROUSER RIGIDLY IN PLACE

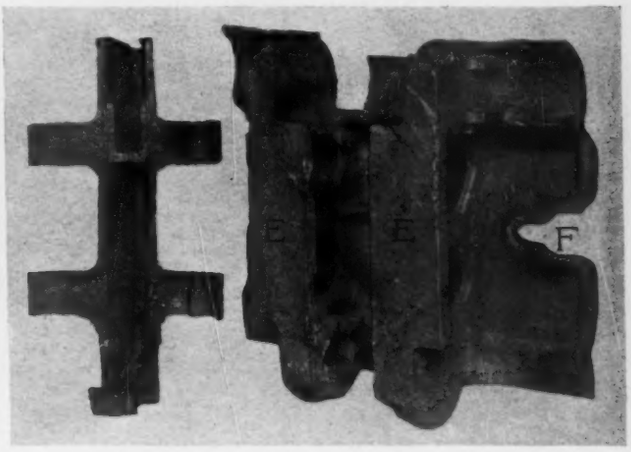


FIG. 3—WEBS WERE DESIGNED TO FURNISH THE REQUIRED STIFFENING FOR BOTH THE LINK AND GROUSER—THE ROLLER TRACKWAYS ARE INDICATED BY E, WHILE F IS THE GROUSER LUG SLOT WHICH IS DUPLICATED AT THE OPPOSITE SIDE OF THE SHOE—PIN-HOLES ARE CORED OUT IN ONLY END SIDE OF THE LINK

come to an equal pressure. The entire mold and bottom board is then drawn away by the receding draw table, with the supporting columns remaining in the same relative positions.

Speedy operation characterized the use of this machine in the production of molds for tractor links. K. V. Wheeler, the foundry superintendent, devised his layout in such a manner as to take advantage of every minute possible of machine time. Under his direction a simple, but effective clamping device was rigged to hold the mold against the rollover arms when swinging the mold bottom board is placed and the clamping device is swung over until the U-shaped rod has a firm bearing against the bottom board. A partial turn of the lever end of the rotating rod then serves to bring the small cranks into play, binding the U-shaped bar firmly against the bottom boards, and holds the mold firmly against the pattern while the arm is swung over. A mere touch on the lever and the U member is swung up into the position shown in Fig. 6 while the pattern is drawn.

The layout was designed to co-operate to the fullest extent with this machine background in Fig. 4. The five copes were then rammed on the jolt machine by two operators and swung into place on the corresponding drags. The air hoist was used to handle the copes and close the molds. An overhead crane then picked the entire rack of molds from the *dollies* and carried it to the molding floor directly in front of the electric furnace. The molds were poured while still resting on the rack.

After pouring, the frame was again lifted by the overhead crane and removed to the other end of the foundry where the shakeout floor was located.

FIG. 4—THE LAYOUT FOR MAKING TRACK LINKS INCLUDED THE ROLLOVER JAR-RAMMING MACHINE, A PLAIN JOLT MACHINE, TRACKWAYS AND DOLLIES TO SUPPORT THE MOLDS, THE MOLD RACK AND AN AIR HOIST WITH SPECIAL RIG FOR PICKING UP THE COPES AND CLOSING THE MOLDS UPON THE MOLD RACKS

and pattern from the jolt over upon the draw table. This device is shown at *D*, Figs. 5 and 6. A piece of ½-inch bar was bent into a flat U-shape, with the end members curved in a plane at right angles to the U-section. Rings were formed in the ends of these members, and these rings were placed about a cross member, held so that it would rotate, but firmly attached to the pattern board. At the places where the rings fitted around this cross rod, bends were made to give a crank action when the cross rod was rotated. The cross rod was bent at the end to form a lever.

The operation of the clamping device is simple and rapid. The pattern-board is firmly bolted to the rollover arms. After the mold has been rammed, the which operated on drag molds only. The rollover machine was the master unit and a plain jolt machine and auxiliary handling equipment followed the pace it set. Directly in front of the two molding machines, a wide trackway was constructed. Two four-wheel *dollies* placed on these two tracks supported a cross frame capable of holding five molds. Two complete link molds were made in each flask. The completed drags were lifted from the rollover machine and placed upon this frame or rack by two men who operated the molding machine. Two other men then placed the cores in place, and when the five molds were cored, the frame was pushed along the trackway until it was under the air hoist runway shown in the Here the five sets of flasks were removed and the castings were still supported on the rack. The entire rack with the 10 castings then was removed to the side of the floor and dumped in a pile for cleaning. The racks then were returned to the molding floor. Sand was delivered to the side of the machines and facing sand in boxes was set in place within reach of the molders, through the same service crane which handled the frame units. The bottom boards with the sand containing the used cores were removed to a point near the core sand mixer where they were dumped and the sand was reclaimed.

The production of the tractor links was viewed by the executives of the Zimmerman foundry as a manufacturing

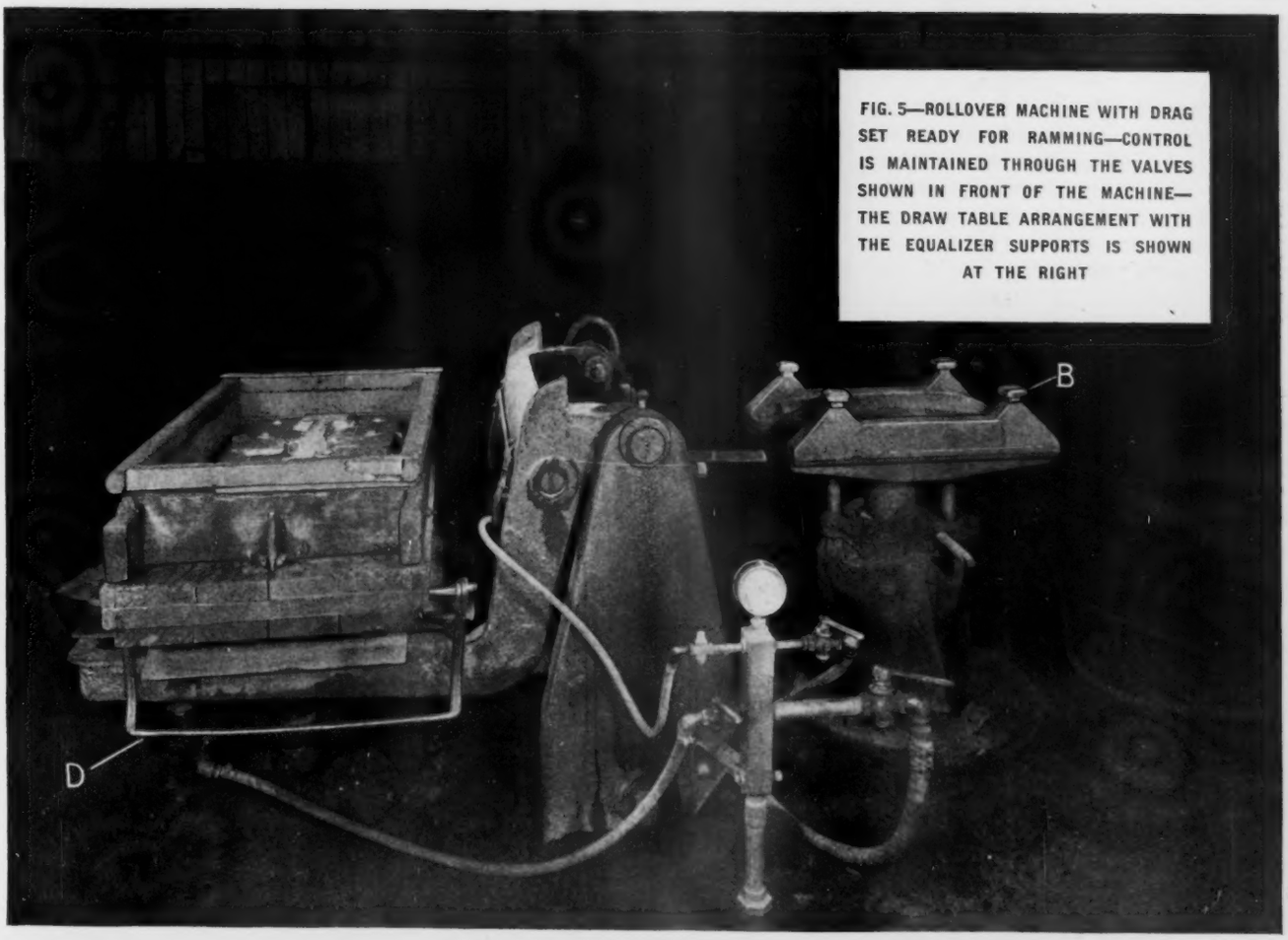


FIG. 5—ROLLOVER MACHINE WITH DRAG SET READY FOR RAMMING—CONTROL IS MAINTAINED THROUGH THE VALVES SHOWN IN FRONT OF THE MACHINE—THE DRAW TABLE ARRANGEMENT WITH THE EQUALIZER SUPPORTS IS SHOWN AT THE RIGHT

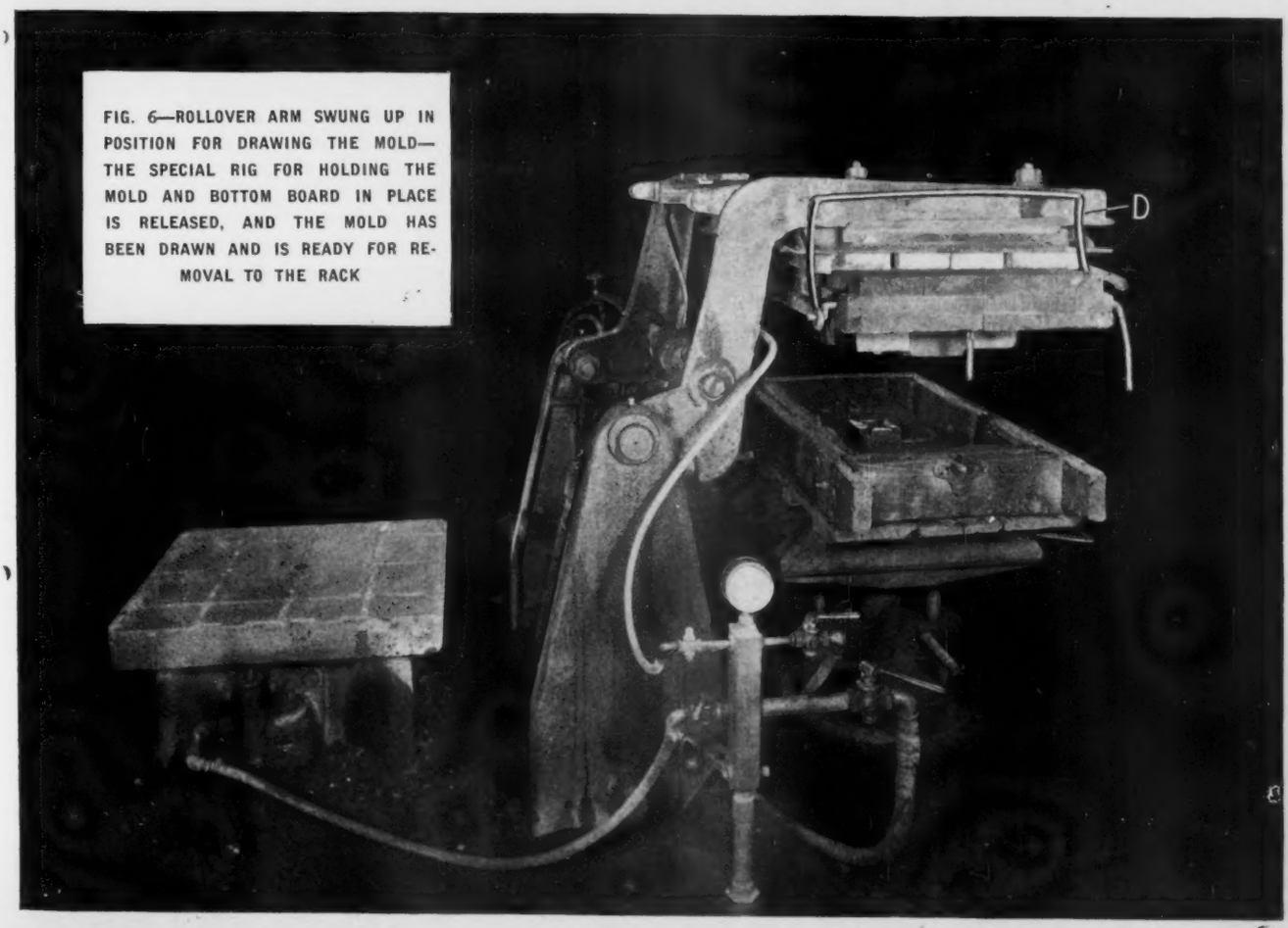


FIG. 6—ROLLOVER ARM SWUNG UP IN POSITION FOR DRAWING THE MOLD—THE SPECIAL RIG FOR HOLDING THE MOLD AND BOTTOM BOARD IN PLACE IS RELEASED, AND THE MOLD HAS BEEN DRAWN AND IS READY FOR REMOVAL TO THE RACK

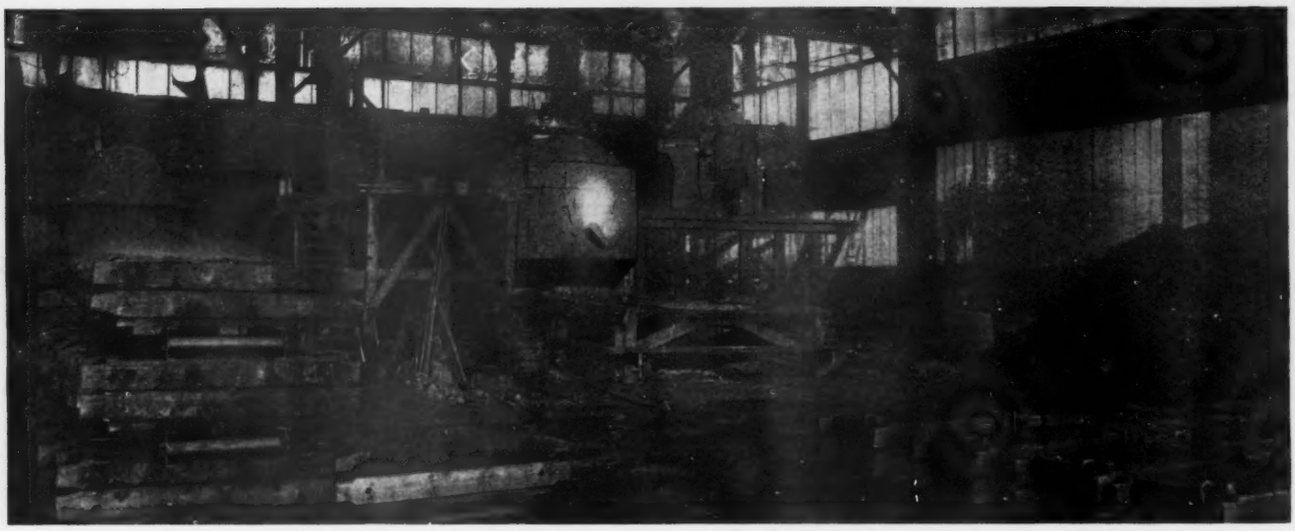


FIG. 7—MAIN MOLDING FLOOR WITH RACKS OF COMPLETED MOLDS IN PLACE BEFORE THE ELECTRIC FURNACE—THIS FLOOR WAS ENTIRELY FILLED WITH MOLDS IN EIGHT HOURS

problem. The two machines used by two crews stimulated a spirit of friendly rivalry, or at any rate, an effort on the part of one crew to keep up with the mold production of the other. The fact that a third crew set the cores accentuated this spirit and the result was noted in a rising curve of production until on the day when the screeching of factory whistles in Davenport announced the armistice, a steady output of 200 molds per 8-hour day with the team of six men had been attained. This meant molds completed for 400 tractor links per day from a foundry which had previously attained top production and did not extend its labor force. A duplicate of the molding machine equipment was on the floor ready for installation and another week would have seen an output of 800 tractor shoes per day.

Molding Difficulties

The accompanying illustrations will serve to indicate the difficulty of molding the shoes. Some foundries which undertook the production of these castings experienced trouble through warping in the center of the shoes. This was due to shrinkage resisted by the cores forming the central hollow between the inner or track flanges of the shoe. It even became necessary in some assembly plants to install presses to straighten the links when they were put together. The Zimmerman plant met this difficulty by crowning the pattern slightly, so that the shrinkage brought the surface only to the required position.

As may be noted from a study of the illustrations the track links were molded erect in the drags. Six cores were necessary in each link mold. The three main cores formed the back of the tread with the two track sections, which in the completed link form a trackway for the rollers supporting the tractor as it moves forward. These two track flanges are supported by web sections which are braced against the back of the shoe. The holes for the link pin, by means of which each shoe is hinged to its neighbor at one end are formed by a plain cylindrical core. The slots in which the grouser lugs are fitted are shown at *E*. These are provided by cores similar to that shown in Fig. 3. Obviously, the problem of core capacity to keep pace with the great number of molds made, caused some concern. Temporary oil-fired ovens were constructed to supply the extra cores needed, and changes in the patterns had been recommended to cut down the cores required.

A grouser order assumed by the Zimmerman company at the same time it contracted for the track links, occupied one of the side bays adjacent to the link job. The grousers, shown in Figs. 2 and 3, were molded two to a flask. The layout for handling this job including three molding machines, placed in a line with piles of sand between them. At one end of this line was a plain squeezer manufactured by the Cleveland Osborn Mfg. Co., Cleveland. This was operated by one man, making copes for the grouser molds. Between this machine and the center was a sand pile. In the center was a roll-over squeezer built by the Arcade Mfg. Co., Freeport, Ill. Next was another pile of sand and finally another plain squeezer of the same type as the first. The two plain squeezers, each operated by one man, supplied the copes. The central machine molded two drags simultaneously. The drags were carried to the floor where the cores were placed. The copes were brought from

FIG. 8—CASTINGS WERE DUMPED FROM THE MOLDING RACKS ON THE PILES AT THE LEFT IN THE CHIPPING ROOM—THE BOTTOM BOARDS WERE PICKED UP AND THE SAND WAS DUMPED FROM THEM BESIDE THE CORE SAND MIXER

the outside machines and the molds closed. With this layout 300 molds were produced in an 8-hour day by five men. This meant an output of 600 grousers per day. All molds for this work were poured by hand from shank ladles.

Steel for the grousers and track links alike was supplied by a 5-ton electric furnace installed by the Industrial Electric Furnace Co., Chicago. Miscellaneous scrap and plate punchings were used for the charge. A record of 12 heats in 24 hours had been made with this furnace. Metal was supplied for locomotive frames, tractor and general railway castings in addition to the track shoe and grouser jobs.

Exceptional care was exercised in the cleaning of the track links and grousers, due to the fact that surface irregularities would hinder assembly. The castings were removed from the rough chipping floor where they were dumped from the mold racks, and broken apart. Gates and risers were cut off with pneumatic tools. A pressure sand-blast, built by the Pangborn Corp., Hagerstown, Md., was used to remove the sand particles. Some of the castings then were tumbled in a sand-blast barrel constructed by the Brown Specialty Machinery Co., now the Rich Foundry Equipment Co., Chicago. All surface projections, or inequalities were next ground off and the castings were removed to the annealing furnace. The three furnaces were designed and constructed by the Zimmerman engineering staff. The links and grousers were annealed at 1600 to 1650 degrees Fahr. and allowed to cool in the furnace, after which they were removed to the weighing platform by a magnet, manufactured by the Cutler-Hammer Mfg. Co., Milwaukee, and carried on a 5-ton crane built by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Physical inspection at this point and supervision of steel analysis were the only control factors exercised by the ordnance department on this work. The steel required for track links and grousers had to meet the following specifications: Carbon, 0.20 per cent; silicon, under 0.30 per cent, and manganese, from 0.45 to 0.50 per cent. Machining and hardening preceded assembly of these parts at the various plants where they were set up with the completed tractors.

The Zimmerman Steel Co., through its efficient handling of this urgently needed class of equipment found opportunity to carry on the other government and allied work. Similarly, it was enabled to serve the most urgent needs of its established customers for tractor parts and commercial castings. The company has made steel castings for a number of years. In fact when located in Lone Tree, Ia., it established in 1906 the first steel foundry west of the Mississippi. Its earlier operations in gray iron dated from 1895 when it manufactured stump-puller castings with a home-made cupola made from a boiler shell, set on oak posts and with a wooden bottom. In 1915 the company removed to Bettendorf, near Davenport, Ia., and set up its equipment for the making of locomotive, excavator and tractor castings. The return to peace-time operations will entail no great effort on the part of this foundry as the character of its work has not been widely different during the war demand.

The head of this interesting foundry is William C. F. Zimmerman, the founder of the old plant at Lone Tree, Ia. His three sons, J. E., H. L. and F. W. Zimmerman, are associated in the executive and supervising capacities over the entire plant. C. A. Atherton is plant manager and K. V. Wheeler is foundry superintendent.

FIG. 9—SIDE BAY IN WHICH THE GROUSERS WERE MOLDED IN SNAP FLASKS—THE COPES WERE MADE ON THE TWO SQUEEZERS AT THE SIDE; WHILE THE MACHINE AT THE CENTER PRODUCED THE DRAGS

Maintaining Costs in Receiving and Shipping Departments

By Dr. Robert Grimshaw

There are two reasons for the separation of the activities of the receiving and shipping departments, one from the accounting point of view and the other to prevent possible irregularities.

From the point of view of accounting it is desirable to keep the expenses of receiving materials and supplies apart from those for shipping the finished product, because the first go directly into the cost of the materials delivered at the point of consumption and should be charged to cost of materials, hence they belong to production; the second are practically sales expense items. The combination of the two not merely may lead to bad distribution of costs and lack of control of departmental activities, but to losses, such as selling some castings to outsiders, and machining others where the concern has both foundry and machine shop. If both the receiving and shipping charges are debited to a combination receiving and shipping account, machined articles which are sold will be charged twice to this expense.

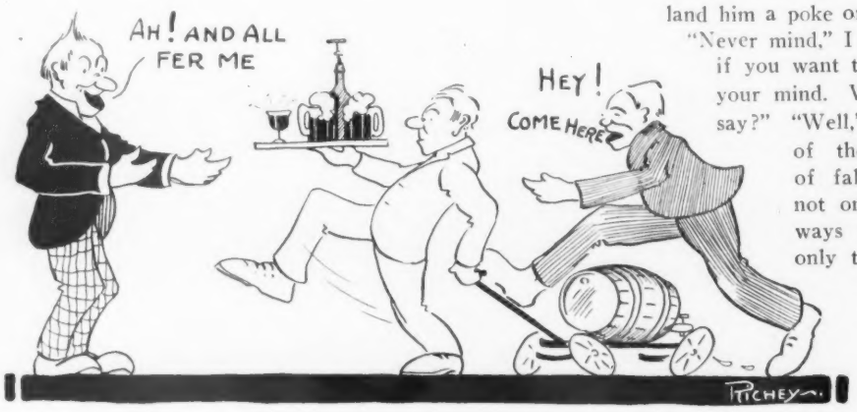
For the physical separation of the two departments there is the argument that otherwise opportunity is offered for the combination receiving and shipping clerk receipting for, say a car load of material sold personally.

Bill Attends a Molders' Smoker

While the Hilarity Reigns, He Discusses a Few Kinks of Shop Practice, Which Increased Output

By Pat Dwyer

THE molders of this district held a smoker and *get-together* one night recently. They buried the hatchet temporarily and graciously invited the *gaffers* from the different shops to come along and enjoy themselves like ordinary human beings for one night. It was certainly one grand night. The machinery was triple-stiff at first, but after a committee of oilers had passed around a few times, pouring lubrication in the different bearings, the effect was surprising, not to say hilarious. The old machine fairly hummed until midnight. In fact she was going so swiftly that hot boxes developed all over the hall. The place was filled with smoke and the oiling committee was kept busy to prevent spontaneous combustion.



THE FIRST ROUND BILL SHINES

I found myself sitting between old Bill and the foreman of another shop. The latter was telling us of a stunt he pulled off lately. He had a big brass nut to cast, too big to melt in the usual way, so he had melted the stuff in the cupola. He explained at great length what a particularly hazardous and risky piece of business this was and as much as intimated that it had never been done before.

"Dear friend," said Bill, "I don't like to be impolite, especially on a festive occasion like this, but that idea is older than either, or both of us. I have seen it done when I was a boy; have seen, and heard of it being done in lots of shops since, and have done it myself on several occasions. I had an old molder of nearly seventy working with me one time and he had told me of casting 9-foot propellers that way when he was a young fellow, and in a shop where the equipment and building were so antiquated that they had to put a prop under the jib of the crane before they risked lifting the ladle. The foundry business is so old, dating back as it does further than I could tell you, and twice as far as you could tell me, that there can be very few tricks of the trade that were not tried out by somebody, some time. To quote that classy old bird Solomon, 'There is nothing new under the sun,' and he knew a few things, including foundry practice.

"It is quite true that in a great many ways modern foundry practice does not resemble that of a century or two ago. But it is only in details. The basic principle remains the same. Molds have to be made and metal melted to fill them. When the boys return from Europe, they will be able to tell of castings they have seen, made centuries ago, that would tax the very best modern foundry to duplicate, either in size, weight or finish. When you come to think of it, it is simply remarkable how all of us persist in focussing our eyes and minds on what is close at hand. It is a natural failing for us to think that our country is the best in the world, our town the best in the country, and our shop the best in town. We are firmly convinced that if we do something out of the ordinary that no one else ever did it before, and we have our doubts if anybody else could do it.

"I attended divine service last Sunday and the preacher was holding forth on the subject of *Falsehood*, and do you know he handled his theme in a very interesting manner. I do not always agree with his views, and on these occasions I generally go to sleep, but this time I heard him right through."

We were interrupted here by the chair calling on our friend for a *few remarks*. When he had gone, Bill continued:

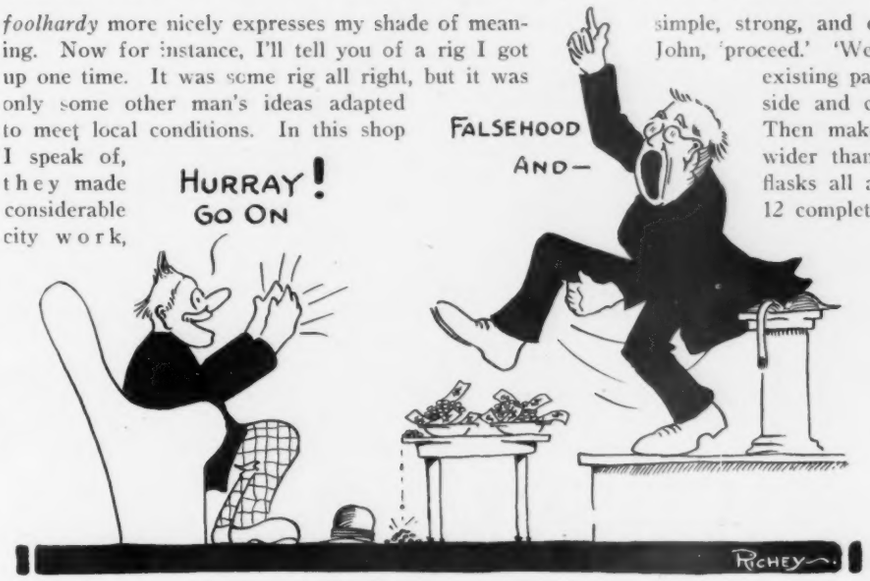
"That's what I call hard luck, just when I had him in a good position to land him a poke or two."

"Never mind," I said, "I'll be the goat if you want to get that sermon off your mind. What did the preacher say?"

"Well," said Bill, "he spoke of the general prevalence of falsehood in the world, not only now but as it always has been. We not only tell falsehoods to others but we try to deceive ourselves by either ignoring, or refusing to look at what is perfectly obvious. We pander much to our pride by thinking we are different and better than other people, and that when we die there will be a distinct gap left in the jaw of time. Of course, Father Time is generally represented as a toothless old rooster with nothing much but a long beard and a scythe, but if you ever have a tooth blasted out by a dentist, you know what I mean.

"Now you know me Al, I have been around and probably seen and done as many queer things as this hen who melted the brass in the cupola, but I am not claiming originality for them. We must admit that while every conceivable angle of the foundry game has been touched by some men during the past several thousand years, he would be a very brave man who claimed that *he* had touched all of them. On second thought, brave is not the word. I think

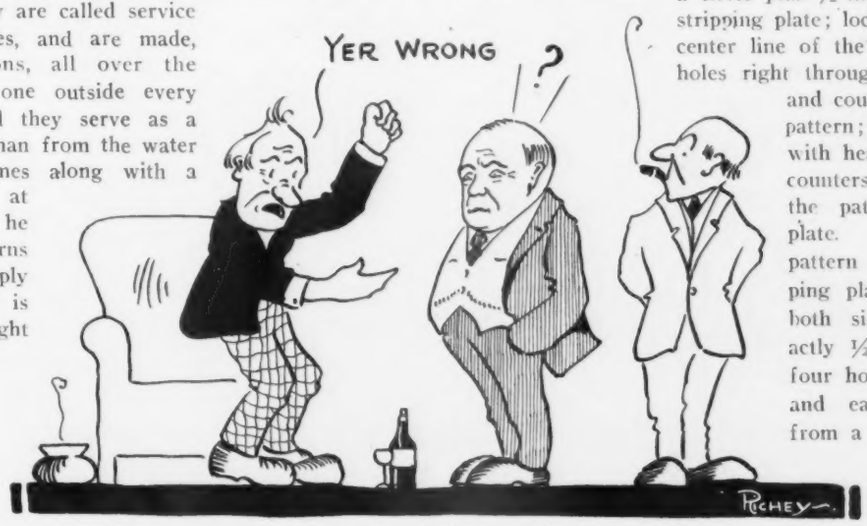
foolhardy more nicely expresses my shade of meaning. Now for instance, I'll tell you of a rig I got up one time. It was some rig all right, but it was only some other man's ideas adapted to meet local conditions. In this shop I speak of, they made considerable city work,



BILL OK's THE SERMON

and one of the jobs was a 2½-inch pipe, 3 feet long, with a bell and flange combined at one end. You probably know what it is like. They are called service boxes, or stand pipes, and are made, with slight variations, all over the country. There is one outside every house in a city and they serve as a convenience for the man from the water department who comes along with a long rod, worked at one end, which he shoves down and turns off your water supply if your water rent is not paid up. I might say parenthetically, that I wish I could get up a rig for paying rent and taxes. But never mind that just now, let us finish the job in hand first. These pipes were formerly made off a split pattern, in little wooden boxes, and as the demand only averaged about 300 a year, the job was made by a boy. What with shifted copes, runouts, drops, pouring short, and other accidents usual with boys, the job was in the shop practically from one year's end to the other. It was a constant thorn in my flesh. It was one of the 157 different varieties of aggravations which earn for the foundry foreman the title of 'an old grouch.'

"Being by nature a kind-hearted kind of an old devil, and having learned by years of experience, that it is better to find an easier way of doing a thing than growling about it, I gave this thing a general once-over, and it looked to me that this would be a good time to pinch some of the ideas of these molding machine people. I laid the proposition before my fellow conspirator, the patternmaker, and he, being a choir leader and deacon in the



BILL CALLS HIS BLUFF

church, was of the opinion that it would be a holy and wholesome thought to do so. 'Now, says he, 'Bill, what's the general idea?' 'Well, John,' says I, 'if we had about a million of these to make I would get up something classy, or buy one ready made, but as the job only runs about 300 a year we will rig up something in an amateur manner; plain, simple, strong, and chaste in design.' 'Chaste is good,' says John, 'proceed.' 'Well,' says I, 'we will take our half of the existing pattern, make it ⅛-inch thicker on the joint side and cast one off it solid, core prints and all. Then make a flat plate 1 inch thick and 4 inches wider than the pattern all around. Then make 24 flasks all alike, copes and drags. This will give us 12 complete flasks. Then we will make a stripping plate, ⅝-inch thick and the same contour outside as the flasks. The stripping plate and flasks to have four lugs cast on, each to be drilled for pin holes and the flasks to have three pieces of 1-inch pipe cast in, two in the wide end, and one in the narrow end, to serve as handles. When they are all cast we will take them into the machine shop. We will tender the machine-shop foreman our plug of tobacco and tell him to go as far as he likes. Having thus established friendly relations, we will lead him over to the pile and ask him to plane the bottom plate off true and draw a center line on it; plane off the face of the pattern until it is exactly half a circle plus ½-inch, to allow for the stripping plate; locate it exactly on the center line of the plate and drill two holes right through pattern and plate and countersink holes in the pattern; then run two bolts with heads turned to fit the countersink through and bolt the pattern firmly to the plate. After bolting the pattern on, take the stripping plate and plane it on both sides until it is exactly ½-inch thick; lay off four holes, one in each lug and each pair equidistant from a center line; lay this plate on the bottom plate and drill four holes in the latter to correspond to the holes in the former. These holes to be threaded and four pins screwed in firmly. The stripping plate can then be used as a jig to drill the lugs in the flasks. Then make

BILL'S THERE WHEN IT COMES TO SINGING

four pins with heads on them, about 3 inches long and a nice easy fit to serve for locating the copes. That will be all, thank you. Let us know when they are ready.'

"Well, we got them after a while. You know how those machine shop people are when doing a job for the foundry. We rigged up a trestle and I got one of the apprentices over and gave him a hand to ram up a few of them. Then told him to go to it, and the result was a joy and delight. The 12 drags were rammed up first and laid out in a row and it was a positive pleasure to look at them; all exactly alike, nice, clean level joints, and no need of mending or patching any of them. The copes were located by the pins referred to. As each cope was put on, the pins were removed and used in the next one. We used a small flat set gate on the joint of the cope. It could have been in the drag, but then we would have to guess where to punch the sprue in the cope, but by placing it in the cope the sprue could be located before ramming up.

"The bottom halves of the cores were made in dry sand and then using the same core box, green-sand halves were blocked on top of them. By using a 5/8-inch rod in the dry halves, no chaplets were necessary. The boy used to make the 12 in the forenoon, including blocking his own cores; and what is more remarkable, he made the whole 300 at one run and never lost one. In justice to this young fellow I must say that no other boy ever equalled his record. Other boys have made them since and occasionally lose one or two, but seldom.

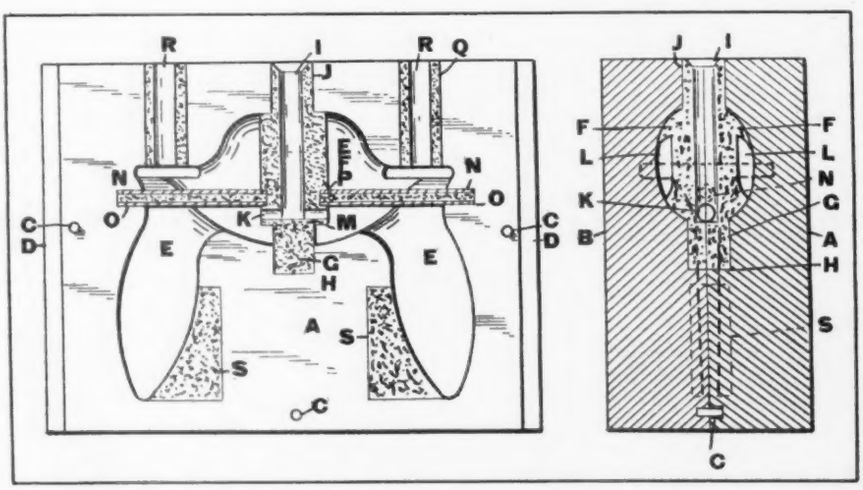
"The initial cost of the rigging was not much, and it has certainly paid for itself many times, to say nothing of the peace of mind it afforded me."

I was just going to ask Bill to go over some of the details again, when the chair called on him for a *few remarks*, but Bill, being wise in his generation, volunteered to sing instead, and oh! boy, I wish you could have heard him caroling "I'm Off to Philadelphia in the Morning."

Casting Steel Anchors in a Permanent Mold

FOR the purpose of saving time and expense in preparing a fresh sand mold for each casting, Frederick Baldt Jr,. Tarentum, Pa., recently developed the following method for casting anchors which is covered by patent. Aside from its time-saving feature, the inventor sets forth that a uniform product results from his process and that the mold may be used repeatedly.

In the accompanying illustration, *A* and *B* are the two halves of the permanent mold, held in proper relation to each other by the dowesl, *C*. The mold halves are provided with side flanges, *D*, for convenience in handling. On the inner face of each half half are depressions, *E*, which form the flukes of the anchor. These depressions are formed by a sand core, *F*, which is made in halves, one-half of which is mounted in each of the permanent mold halves according to manner shown.



PERMANENT MOLD FOR CASTING THE HEADS OF STOCKLESS ANCHORS

The inner end of each half core is provided with a foot, *G*, which fits into a corresponding print, *H*, in the permanent mold. Each half core is provided with half of a pouring gate, *I*, which extends up through a corresponding half, *J*, of an opening formed in each permanent mold. Thus, when the mold is assembled, a pouring gate is formed extending from the top of the mold into the sand core. From the inner end of the pouring gate, branches extend through the sand core to distribute the molten metal to either end of the head. These branches are formed in two halves, *K*, in each half core.

The core is provided with an opening, *L*, at either side for the flow of the metal to form the side walls of the central recess in the head. This connects the end portions of the head. The lower end of the core at either side of the feet, *G*, is rounded off as at *M* to form semicircular or arc-shaped internal shoulders in the recess upon which the cylindrical crosshead of the anchor shank is to bear and rotate.

In casting, the longitudinal hole in the head is formed by means of two lengths of iron pipe, *N*, which are rammed full of sand. Their outer ends are stopped in prints, *O*, in the permanent mold halves while their inner ends are stopped in similar points, *P*, in the sand core. If desirable, cores can be substituted for the pipe.

Each permanent mold half is provided with one-half of a feed hole, *Q*, at either side of the pouring hole so that when the mold is assembled an opening is formed at either end extending up the main cavity, *F*. These holes should be provided with a sand core lining to save the permanent mold from damage by the molten metal.

To allow for shrinkage and the escape of gas along the inner edges of the portions of the cavity, *F*, in which the flukes are cast, recesses, *S*, are provided. These recesses are tamped full of sand to form the inner edge wall of the fluke molds when the permanent mold is assembled. In practice the core halves, *E*, are mounted in the permanent mold halves; the pipes, *N*, are placed in position in one of the half cores; the recesses, *S*, are tamped full of sand and the linings, *R*, are placed in the openings, *Q*. The mold halves are then assembled and the metal is poured through the gate, *I*, until the flow through the holes, *Q*, show that the mold is full.

The general offices of the International Oxygen Co. have been removed from 115 Broadway, New York, to the company's Waverly works, Newark, N. J. By the removal of the general offices to these works the executive, sales and production departments are centralized.

How the Engineer Can Save Foundry Labor

The Author Urges Foundrymen to Pay Close Attention to Casting Design as a Means of Increasing Output—Advantages of Molding Machines

By E S Carman

THE American people are just beginning to realize that they really never knew the correct definition and meaning of the word "saving." We have been an extravagant people, producing anything and everything to add to our comfort, and in the years gone by he was considered a genius who could create and produce, even at the most extravagant cost of labor and wealth, an article that would bring additional comforts to men; but we are today facing a new condition and he is considered a genius who can create and produce an article which will be the most destructive to man.

This business of war, in which the whole world was engaged, required that every available man and woman be made to produce war materials with the greatest efficiency possible, and doubtless all wars will be won by that group of nations which produces the maximum with its available manpower. Therefore, we Americans early determined that every effort should be put forth to obtain the maximum production per man in order to win the war. Progress in this line has been made in many industries; but the industry that most concerns us, as foundrymen and engineers, is that of the foundry in all its various phases. Let us make a full analysis of the foundry and see whether or not we are getting the maximum production per man, and if not, let us place if possible, the responsibility for not having obtained the maximum.

FIG. 1—TUNNEL SEGMENT MOLD MADE ON A MOLDING MACHINE

Foundry operations may be divided into classes as follows: Yard work, handling of pig iron, scrap, coke, flask equipment, etc.; sand handling; molding; melting and pouring iron; and shaking out and cleaning the castings.

In the specialty foundry, the foundry producing duplicate castings in large quantities, there has been a satisfactory advance in the saving of manpower per pound of output by the installation and use of yard cranes, motor-driven yard trucks, electric magnets, sand conveying systems, molding machines, pouring machines, shakeout machines, sand blasts, tumbling mills, etc. The best specialty foundries are equipped with practically all of the foregoing and are still looking for other means to reduce manpower by the use of money-power.

The engineer has had his part in the design and production of all the equipment named in the foregoing paragraph, which efficiently performs the function required of it. There is, of course, opportunity for further development and improvement, if such as we now have available is made use of by the foundry industry in general, a great saving of manpower will result.

The engineer has performed his duty in regard to the design of the equipment for foundry use, but I wish to ask the question, "Has the engineer performed his duty in regard to the *product* that the foundries are turning out?" As the foundry output is castings only, I ask again, "Who, if not the engineer, is responsible for

A paper presented at the annual meeting of the American Foundrymens' association held at Milwaukee, Oct. 7-11. The author E. S. Carman, is associated with the Cleveland Osborn Mfg. Co., Cleveland.

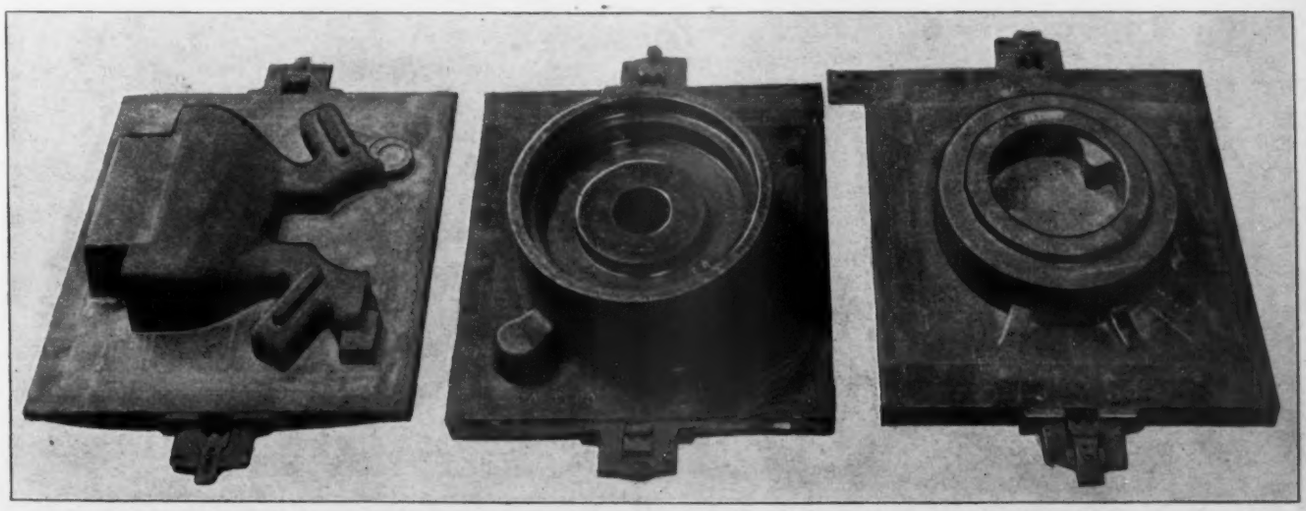


FIG. 2—GROUP OF JOBBING FOUNDRY PATTERNS MOUNTED ON WOOD PATTERN PLATES FOR MACHINE MOLDING

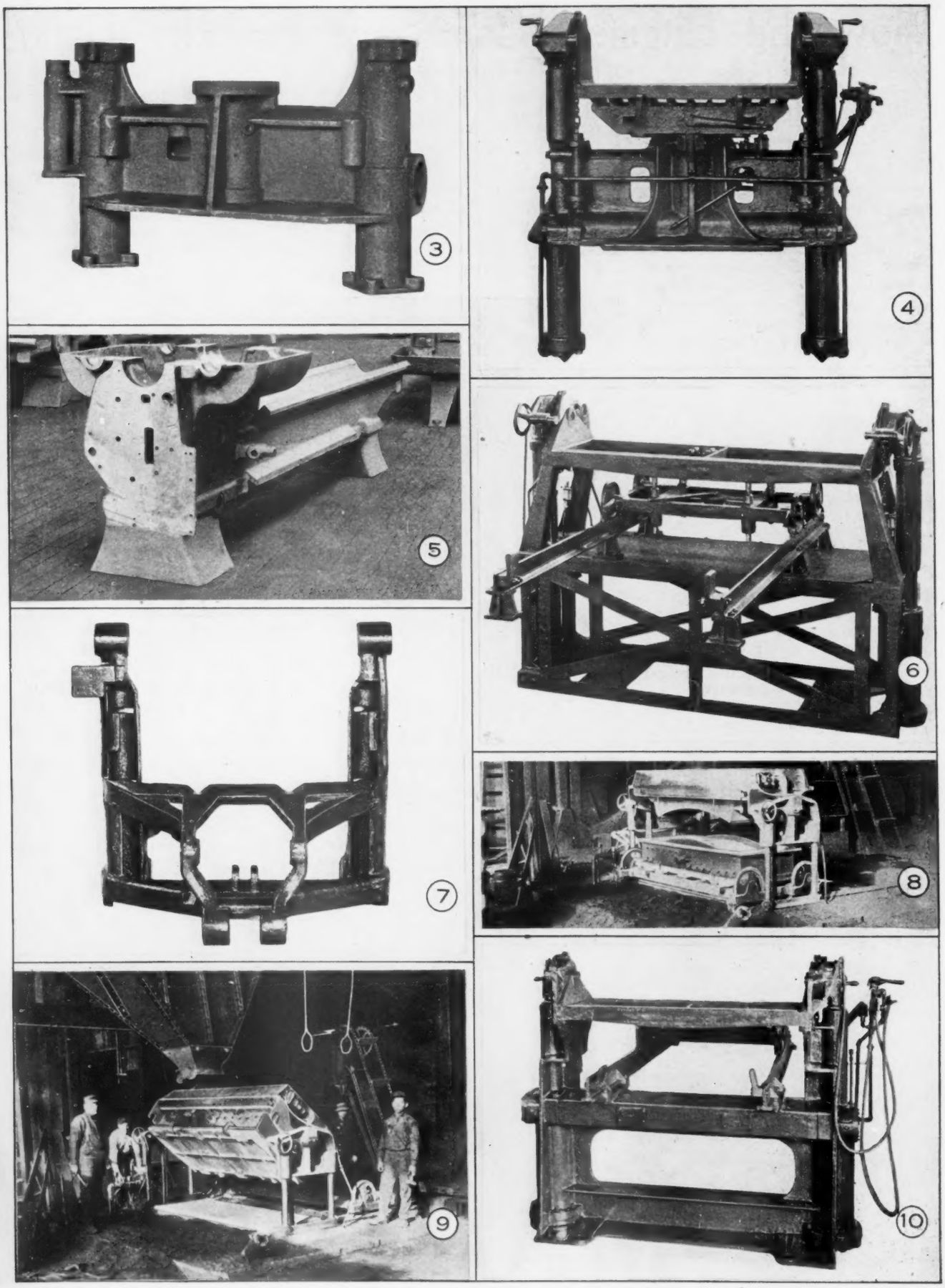


FIG. 3—CASTINGS MADE TO ELIMINATE UNNECESSARY MACHINING FIG. 4—THE SAME DESIGN BEFORE IT WAS IMPROVED FIG. 5—DIFFICULT CASTING TO MOLD FIG. 6—MACHINE COMPOSED OF SEVERAL CASTINGS FIG. 7—CASTING DESIGNED TO ELIMINATE JOINTS FIG. 8—MACHINE SHOWN IN FIG. 9 WITH MOLD ROLLED-OVER AND PATTERN DRAWN FIG. 9—JAR-RAM ROLL-OVER MACHINE USED IN MAKING TUNNEL SEGMENT MOLDS FIG. 10—MACHINE IN WHICH MACHINED JOINTS ARE ELIMINATED

Table I

Memorandum of Saving in Ship Castings

—Castings required—		Machine molding					—Hand molding—				—Saving—		
Name	Quan.	Mch.	A	B	C	Cost, ea.	A da.	B da.	C	Cost ea.	Val.	%	Man days
A—Low pressure Cly.—45-in. bore	24	407	4	4	6	5.25	1–3	2–3	72	31.50	$ 630	83	120
A—Int. Cyl. 24-in. bore	24	407	4	4	6	5.25	1–5	2–5	120	52.50	1134	90	216
B—High pressure Cyl.—20-in. bore	24	407	5	4	5	4.20	1–1½	2–1½	36	15.75	277	73	52
C—Housing	72	407	15	4	5	1.40	1	2	72	10.50	655	87	124
D—Propeller	24	407	4	3	6	4.13	1	2	24	10.50	153	60	30
E—Steering Eng. Cyl.	24	406	20	3	1	.83	1	2	24	10.50	232	92	47
E—Vent. Gear	72	406 or 407	20	4	4	1.05	1	2	72	10.50	680	90	56
Total	..	...	..	26	..	...	.....	14	..	....	$3761	..	645

Total saving, $15,000 per month

Average percentage of saving, 85 per cent.

A—Output. B—Men. C—Time.

casting design? Who is responsible for the casting with a core so large and heavy that it cannot be supported by the available core print, and, if perchance it can be supported, what about removing the core after the mold is poured? And then again, who is responsible for all the fancy beads, extending lugs, recesses, sharp corners, joining thin and thick sections of metal and many other unnecessaries?" All of these retard production and in some instances prevent the use of machine molding, requiring instead the greatest manual skill to secure even a low production.

The engineers will answer, "Well, what is that to us? Shall we spend our time looking out for the foundry? Does not the foundry give us any and most everything we design, and that too without speaking a word of complaint?"

Well, foundrymen, I'm ashamed to say it, but I believe they are right. For all these years you have gone on and on, giving the engineer everything he designs, putting up with the same old difficulties, and making the castings in the same old way. The foundrymen will admit that this is doubtless true and ask: "What can we do to help matters?" I reply, "Use all the knowledge you have, for the present, and endeavor to convince the engineers that they should give due consideration to foundry operations."

Is it not time that the foundries produced a man who by education and experience understands that castings, to be made successfully with unskilled labor, should not have some of the complications just mentioned? Let us train such men both in our schools and colleges and in the school of experience. Let us call him a foundry engineer, and when these casting difficulties arise, send the foundry engineer to the customer's engineering department, and point out the difficulties encountered in production, suggesting changes, and in engineering terms meet the objections of the customer's engineer and then offer a substitute. In addition, stay with them until the casting is changed or it is conceded and agreed that no change should be made. This method of procedure may seem slow and it may appear that it would require years to effect any change in the industry, but I believe now is the time to start.

Then, again, because engineers in general are not conversant with what the foundry can do, there is a large amount of manpower being lost in machine shop operations. There are many machined joints being made today that can be made more cheaply and better by casting the parts integral in the foundry.

My years of engineering experience lead me to state that engineers in general, that is, the large majority, do not understand thoroughly either patternmaking or molding, especially machine molding, and consequently they are unable to design intelligently and in the most efficient manner. But in contrast, the engineer is thoroughly familiar with and understands machine shop practice. In his education he has received instructions and experience in up-to-date machine shop practice, while in most cases his foundry training and experience was limited to old methods, and machines, if used at all, were not of modern design.

This lack of interest regarding foundry operations applies in some cases to the management as well, for we find them spending tens of thous-

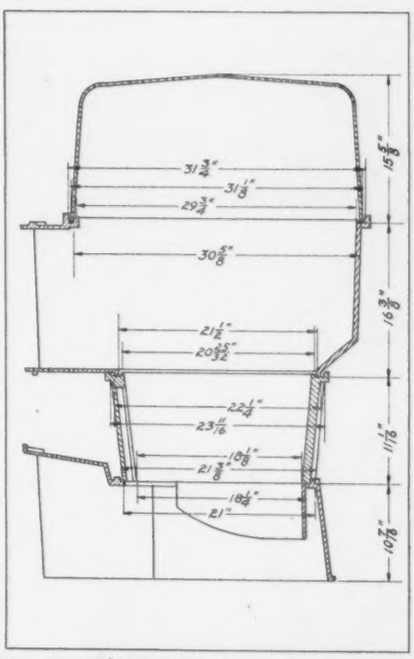


FIG. 11—DESIGN FOR HOUSE FURNACE—CASTING MADE ON MOLDING MACHINE

Table II

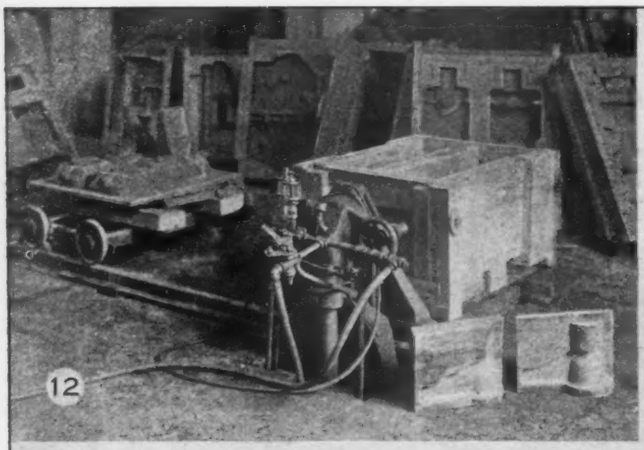
Memorandum of Saving in Ship Castings

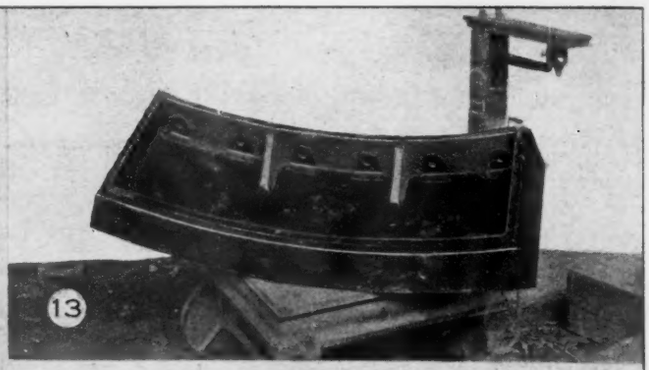
Castings required			—Machine molding—				—Hand molding—				—Saving—		
Name	Quan.	Mch.	Output	Men	Time	Cost, ea.	Output	Men	Time	Cost, each	Value	%	Men days
22-in. Bits—C	600	406 2 bxs.	30	4	20	.70	2	2	300	5.25	$2730	86	520
Core	2400	404	140	2	17	.086	16	1	150	.375	693	77	116
Total	....	...	...	6	..	...	..	3	...	...	$3423	..	636
9-in. Bits—B	1800	406 2 bxs.	35	4	52	.60	3	2	600	3.50	$5220	83	992
Core	7200	404	140	2	52	.086	36	2	200	.33⅓	1780	74	296
Total	....	...	...	6	..	...	..	4	...	...	$7000	..	1288
3-in. Bit—A	600	405	40	3	15	.413	6	2	100	1.75	$802	76	155
Core	1200	403	150	1	8	.04	25	1	48	.24	240	83	40
Total	....	...	...	4	..	...	..	3	...	...	$1042	..	195
Mooring rings Dwg. H-52—No. D	1200	405	40	4	38	.525	9	6	167	3.50	$4462	85	850
No. E	300	...	...	..	..	...	..	..	...	...	....	..	...
Core No. D	2400	403	100	2	30	.12	18	1	167	.33	630	63	107
No. E	600	...	...	..	..	...	..	..	...	...	....	..	...
Total	....	...	...	6	..	...	..	7	...	...	$5092	..	957

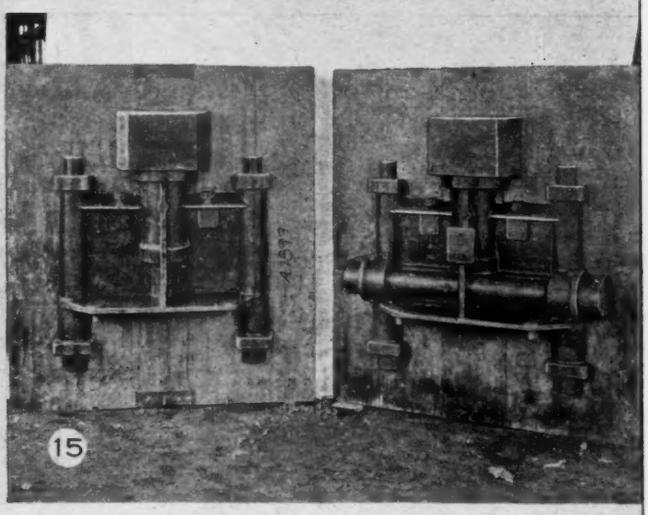
Total saving, $16,577.00

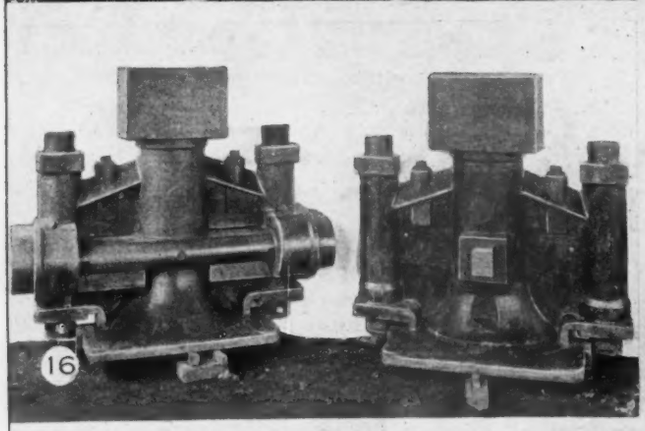
Total amount labor by hand molding (Man Days)	3,767
Total amount labor by machine molding (Man Days)	691
Saving in labor Man Days	3,076

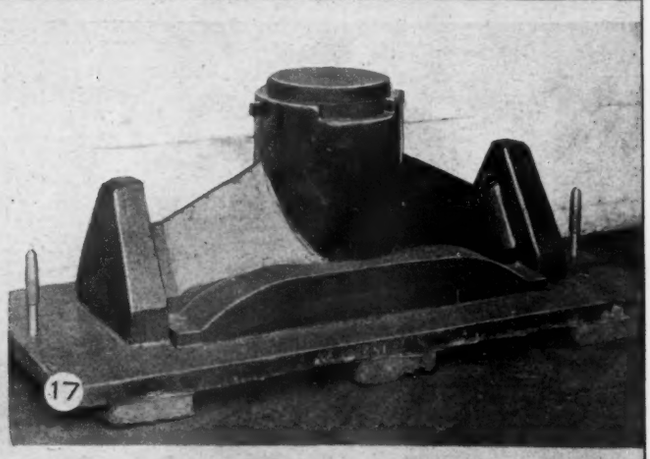
Average percentage of saving, 81 per cent.











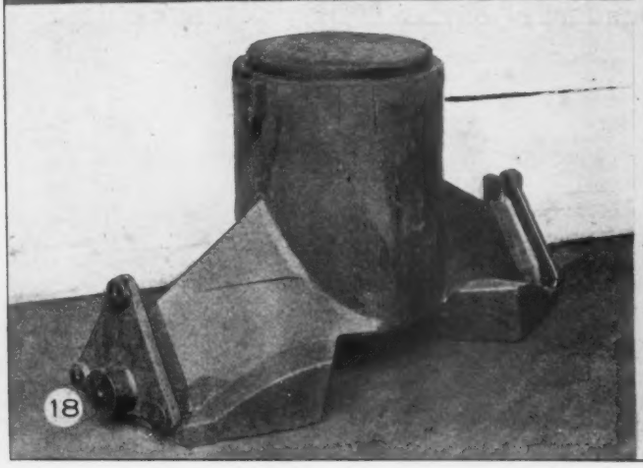


FIG. 12—MOLDING MACHINE ADAPTED TO A VARIETY OF WORK FIG. 13—TUNNEL SEGMENT CASTING WEIGHING 1600 POUNDS FIG. 14—AUTOMOBILE CYLINDERS MADE IN QUANTITY ON MOLDING MACHINE FIG. 15—PATTERNS SHOWN IN FIG. 16 MOUNTED ON BOARDS FOR MACHINE MOLDING FIG. 16—PATTERNS ARRANGED FOR HAND MOLDING FIG. 17—PATTERN SHOWN IN FIG. 18 MOUNTED FOR MACHINE MOLDING FIG. 18—PATTERN ARRANGED FOR HAND RAMMING ON THE FLOOR FIG. 19—WHAT A MOLDING MACHINE CAN DO IN A JOBBING FOUNDRY

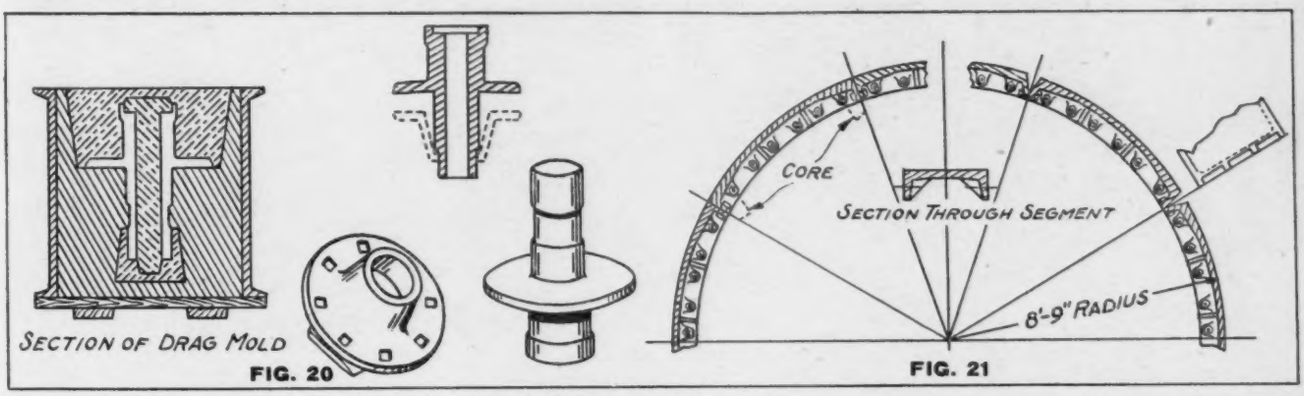


FIG. 20 FIG. 21

FIG. 20—HUB FOR AN ESCORT WAGON, AN UNNECESSARILY DIFFICULT DESIGN FIG. 21—A SIMPLIFIED DESIGN FOR TUNNEL SEGMENTS

ands of dollars for machine-shop tools, where they are not willing to spend hundreds of dollars for foundry tools.

Now, foundrymen, why are these things true? Why not accept some of the responsibility of the present foundry conditions and then do your part in convincing the engineer and the management that the foundry can no longer be overlooked and considered a dirty and disagreeable place, not worthy of consideration.

The specialty foundrymen have been, and are trying to make the foundry a better place in which to work; but there is no reason why the jobbing and other foundries should not be doing their part. The engineer will welcome your co-operation and when you work together for the good of both, then all foundries will be, as the specialty foundries now are, equal in progress to other industries.

The illustrations which accompany this article will clearly and forcibly impress the mind with some new possibilities, especially those of general machine designing and its relation to modern machine molding. They also will show the good results that flow from properly preparing and making the patterns, all for the purpose of saving in the foundry the skilled manpower. We have been accustomed to think of the foundry as a dark, dirty, dusty, disorderly and unhealthy place, but the modern foundry is as light, clean, clear, orderly and healthy as any other of the industrial shops.

Foundry Production Defined

Before proceeding in detail to show the advantages to be gained by the proper consideration of design, I wish to call attention to a few illustrations that will give the engineer an idea of what modern foundry production really is.

Fig. 13 shows a tunnel segment casting, weighing about 1600 pounds. This particular casting was made in large quantities, requiring a continuous run in the foundry for about two years. Fig. 1 shows the mold with overall dimension 8 feet 4 inches long, 42 inches wide and 14 inches deep. Observe in the background the large number of molds that are made and ready to be poured. Fig. 9 shows the machine on which the molds are made. In this view, the sand has been rammed, bottom plates attached and the machine is in the act of rolling-over the mold. Fig. 8 shows the mold rolled-over and the pattern drawn. The output of this casting, before it was placed on the machine, was seven to nine molds a day with a skilled molder and helper, while the output of four laborers, working on the machine, was 141 drags per day. This was a daily performance for nearly two years. Fig. 14 shows an exceptionally large production from still another shop

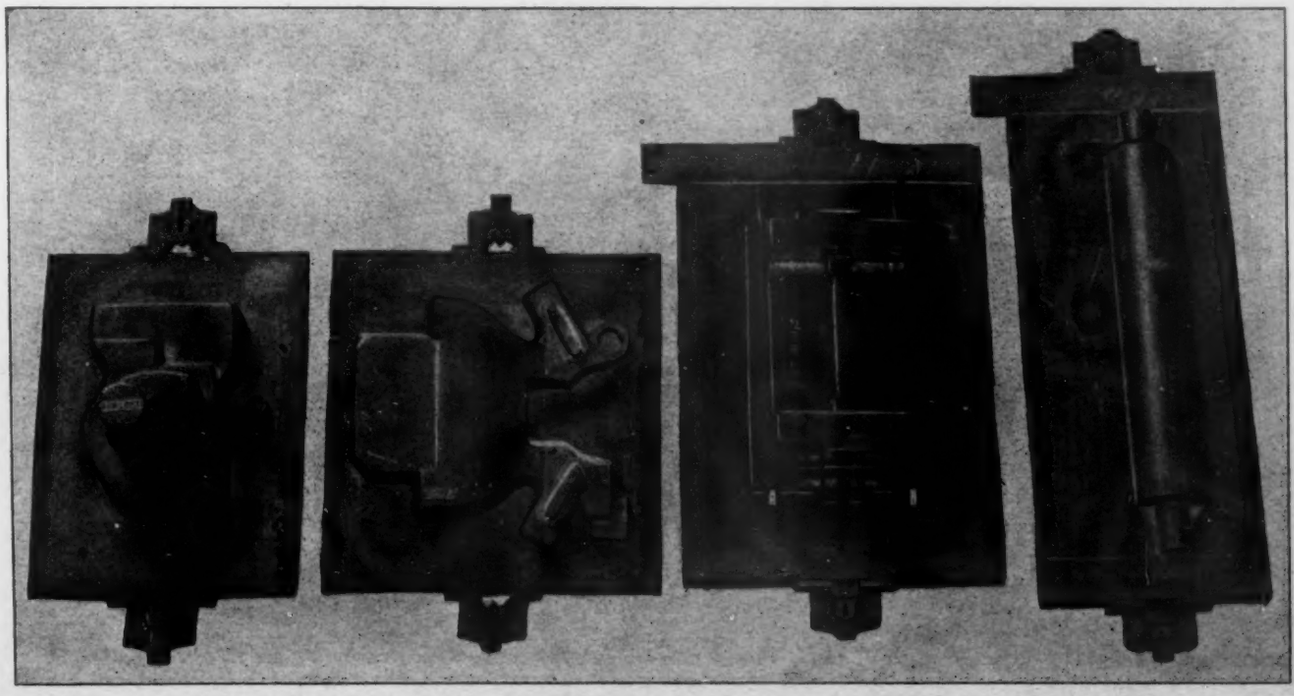


FIG. 22—GROUP OF JOBBING FOUNDRY CASTINGS MOUNTED ON PLATES FOR MACHINE MOLDING

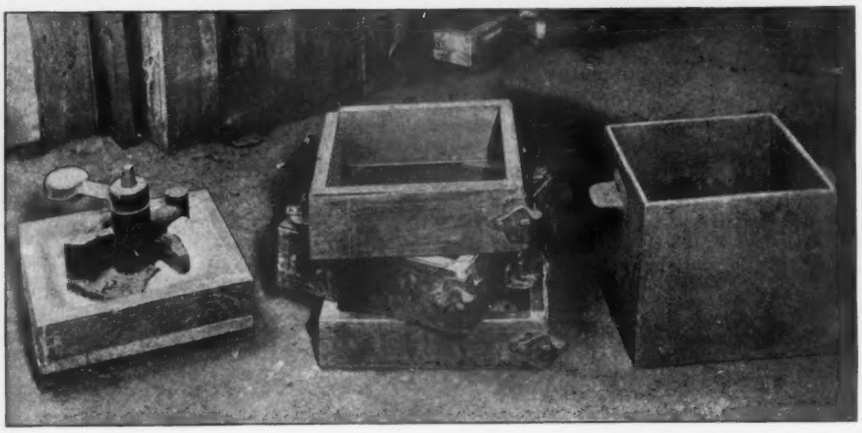


FIG. 23—PATTERN OF A SHAPE BEST ADAPTED FOR FLOOR MOLDING

which is equipped with molding machines.

The foundries thus far shown may be termed special foundries, while that which we are most concerned about is the jobbing foundry or that foundry which does not have large quantity production from individual patterns. Therefore, Fig. 19 gives an idea of what may be accomplished in a day when a molding machine is used in the usual type of jobbing foundry.

The machine shown is a plain jolt machine. It accomplishes only a portion of the full amount of work required in making a mold. Fig. 12 shows a jobbing foundry machine of the roll-over type. The core boxes setting around this machine show how readily it can be changed to handle the many different boxes that are required for this class of work.

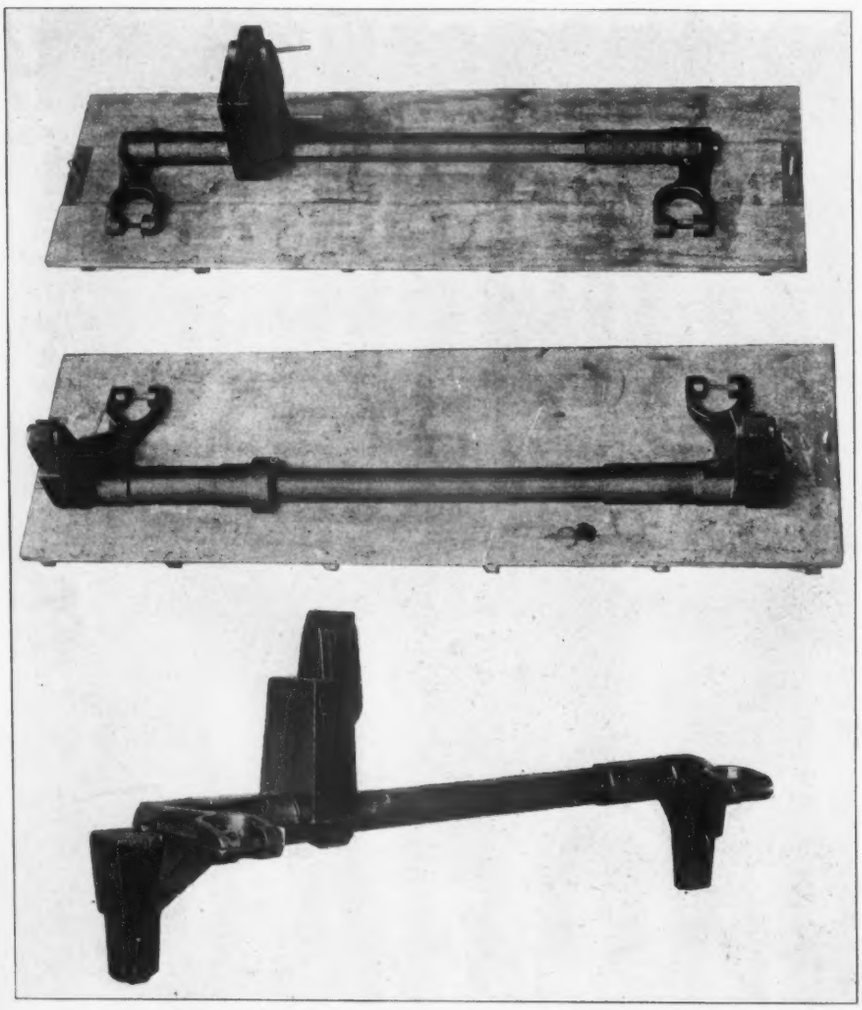


FIG. 24—THE TWO UPPER ILLUSTRATIONS SHOW INTRICATE SHAPED PATTERNS MOUNTED ON BOARDS FOR MACHINE MOLDING—THE LOWER VIEW SHOWS THE SAME PATTERN BEFORE BEING ADAPTED FOR MACHINE MOLDING

The roll-over jolt machine represents the greatest progress made in machine molding as applied to the jobbing foundry. Fig. 10 shows several jobbing foundry patterns made of wood and mounted upon wood pattern plates for machine molding. Fig. 18 shows a pattern as ordinarily made for hand-rammed floor production. Fig. 17 shows the same pattern mounted for machine molding. Fig. 16 shows another pattern as made for hand-rammed molding. Fig. 15 shows a similar pattern when made for machine molding. Fig. 24 shows another large, long, difficult patterns after being arranged on boards for machine molding and before these changes were effected.

Proposed Pattern Making

All of these patterns after being placed on pattern boards for machine molding, showed an increased production of from 100 to 600 per cent, while records show that if the pattern is originally made on a pattern plate for machine molding, its cost is less than when made to be used for hand-rammed molding.

These views are shown in order that engineers and manufacturers may realize that if all their patterns were made for machine molding the price per pound of castings would doubtless be less, and if patterns were so made, it would give the foundries an opportunity to install molding machine equipment which without the co-operation of the engineers and manufacturers they do not wish to do.

Fig. 23 shows a difficult molding job for a foundry. The particular design cannot be criticised as this shape is quite necessary. Therefore, the outfit shown can be used only on the floor, in which manner the greatest production can be obtained. This, however, cannot be said of all the engineer's output as many times the foundryman finds his design similar to Fig. 25, in which he has complicated molding by drawing a bracket with round bosses, while the more economical design would be that shown at the top, in which the bosses or loose pieces are eliminated.

Fig. 26 shows the necessity of the engineer understanding foundry operations for if the mold is to be made on the floor by hand, the rib indicated as "loose piece" in the design (shown at the top) should be on an angle in order to eliminate the core as shown on the bottom of the illustration, but if this particular casting was to be made on a molding machine, the horizontal rib is then

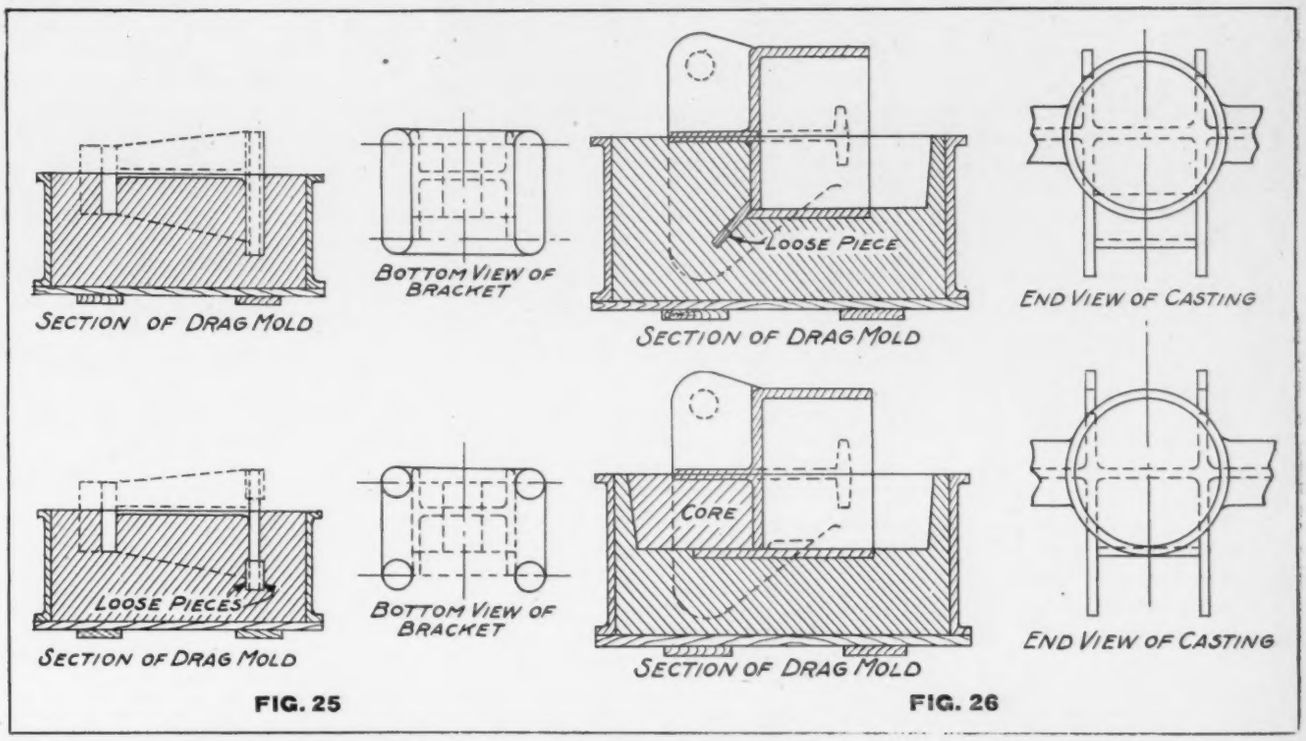


FIG. 25—BRACKET PATTERN WITH LOOSE PIECES FORMING BOSSES SHOWN AT BOTTOM WITH THE IMPROVED DESIGN AT THE TOP FIG. 26—WHY THE ENGINEER SHOULD UNDERSTAND FOUNDRY PRACTICE—NOTE LOOSE PIECE IN MOLD AT TOP

in order, since when made on a molding machine, the loose rib (shown at the top) would not give satisfaction.

Fig. 20 emphasizes the need of thoroughly analyzing the design in the drafting room before permitting it to pass as final. The casting shown in this view is a hub and flange, such as is used on escort wagon wheels. There were 500,000 of these particular castings to be made and, therefore, the more necessity for eliminating from the design anything that would require additional manpower. For some reason or other you will notice that there is a depression in the stem of the hub and because of this depression, we have a difficult foundry operation. There seems to be no apparent reason for this depression for when made as shown above the picture, there seems to be ample strength and in no way does

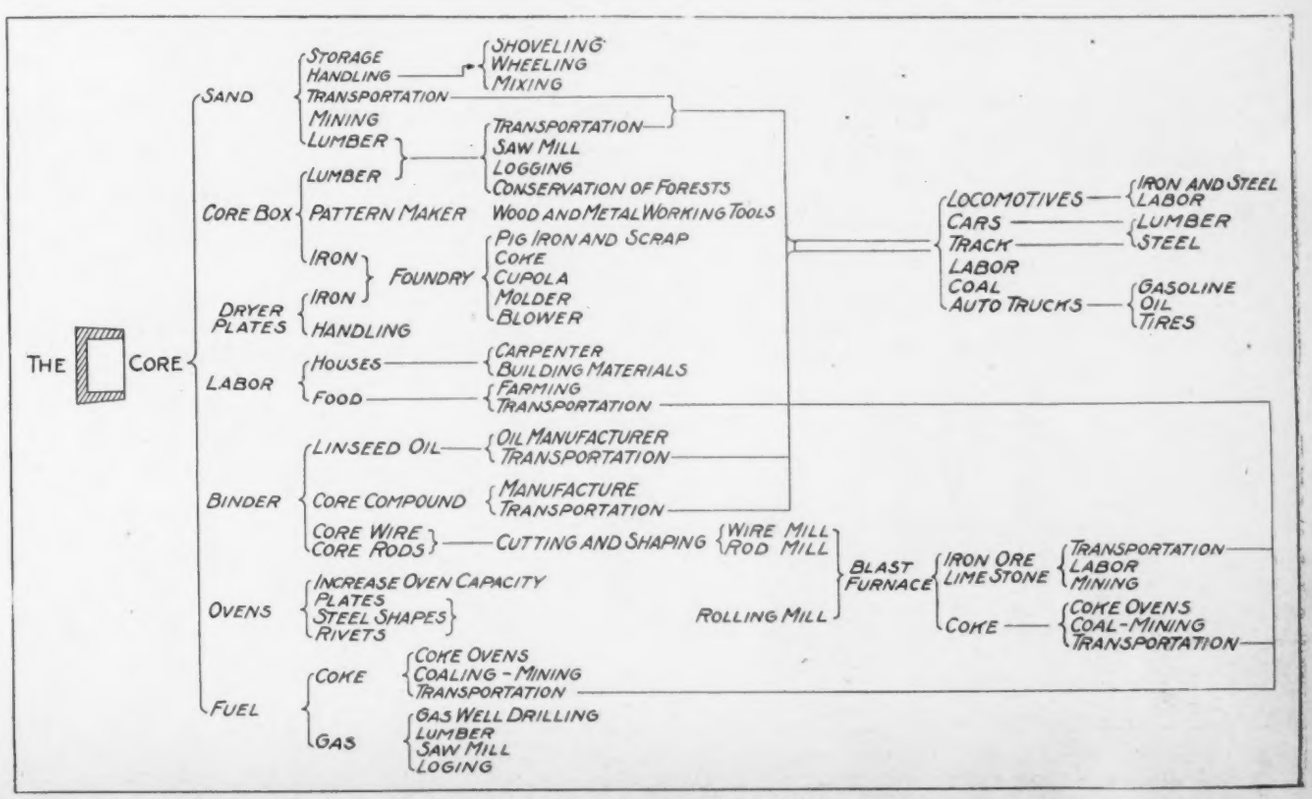


FIG. 27—THE LITTLE CORE FOR THE ESCORT WAGON HUBS SHOWN IN FIG. 20 AND AN ANALYZATION OF THE TROUBLE INVOLVED

this change in the design seem to impair its usefulness. The production of this casting with the depression necessitated the ramming core, which is just above the bottom board, in the mold, while the proposed design without the depression, would not require the core.

Fig. 27 shows this core in detail and the many operations involved in its production, and when we stop to consider that to produce this core for the entire quantity, the cost amounts to over $6000, you can readily see the great amount of manpower that was consumed.

Analyzing the Design

Referring to Fig. 13, the quantity of which was so great, and in analyzing this design for a possible saving of manpower, we wish to suggest the proposed change shown in Fig. 21. By using the design shown at the right of this view, there is eliminated the large core across the end of the mold producing the design shown on the left. The proposed design (at the right) does not at all decrease the strength nor impair the utility of the casting in any way and yet the saving would have been enormous.

In regard to the saving of manpower in the machine shop by a design that will do away with the machining of joints, the following views show clearly the advantages thus gained. Fig. 4 shows a machine, the base of which is cast separately from the side cylinders, necessitating the machining of the joints and bolting them together with finished bolts in order to secure the rigid construction necessary. Fig. 15 shows the pattern of this particular base when made to be cast integral, while Fig. 3 shows a similar casting. You will note that the design is such as to eliminate many of the ribs and projections and practically one-half of the machining time. Fig. 7 shows another example of eliminating machine joints. Fig. 6 shows a machine, the base of which is built up of several different castings with machined joints, while Fig. 10 shows these different parts cast integral in the foundry. Fig. 11 shows the ordinary house furnace which as now designed is successfully made on the molding machine, yet a change in the design would increase and render less difficult its production.

The machine-tool industry perhaps offers the greatest opportunity to the foundry engineer at this time as machines are now being produced in large quantities. Inasmuch as the design is such that it does not readily lend itself to machine molding, I believe that if the present designs were analyzed by a competent foundry engineer, it would be found that in most all cases they could be changed to do away with some of the present difficulties thereby making possible a large production by machine molding. Fig. 5 shows a view of a well known machine-tool bed. This casting was difficult to mold because of its many projections and uneven parting lines.

These views are shown in order to suggest to engineers' minds the desirability of analyzing in detail their designs with a view to eliminating manpower in the foundry as well as in the machine shop. They are also shown in the hope that the foundrymen will feel encouraged to bring to the public's attention the desirability of educating its boys to enter this broad field of opportunity.

The automobile engineers and foundrymen have been pioneers in co-operating, making possible the production of complicated castings in great quantity at a low cost. Their success is clearly shown by the fact that the automobile is today within reach of most everyone in the country, while in the early days of bolted design, the price was prohibitive and raised the ultimate price.

Shipbuilding a Challenge

There are many different machines that are yet to be analyzed and the design changed in order to make the casting a good molding machine operation for the foundry, and the one with which we are doubtless most concerned today is that of castings used in the shipbuilding industry. Since quantities have become large and the design more nearly uniform or standard, a great opportunity is presented to the engineer and foundryman to co-operate, making ship castings by machine molding with its consequent saving of foundry manpower.

Referring to tables I and II, investigation of some of the castings used in this industry shows the enormous gain in manpower possible by the installation and use of the roll-over molding machine, even though the quantities are not as large as heretofore required by the specialty foundries.

Many of the ship casting patterns readily lend themselves to mounting on pattern plates, thereby making possible machine molding, while in other cases it is necessary to design the original pattern to be molded on a machine, and in a few instances designs can be profitably changed to eliminate some of the molding complications.

I wish to urge upon the foundrymen today to do their part in bringing to the shipbuilding engineers' attention the great possibilities awaiting their efforts to eliminate the present great amount of manpower being wasted daily in the foundry industry in the production of ship castings.

Use of By-Product Coke Discussed

H. B. Kirkpatrick, contract manager of the Koppers Co., Pittsburgh, was the speaker at the monthly meeting of the Pittsburgh Foundrymen's association, Feb. 17. His subject was "By-Product Ovens and By-Product Coke," which was illustrated by moving pictures. These were taken at the plant of the Laclede Gas Co., St. Louis, and showed in detail the entire process of making coke in a by-product oven. The paper was followed by a general discussion of by-product coke, more especially applying to its use in cupola practice. Mr. Kirkpatrick and F. W. Spear, the chief chemist of the Koppers Co., answered questions that were freely propounded by the foundrymen.

The discussion disclosed the fact that comparatively few foundries in the Pittsburgh district are using by-product coke. In some instances this is due to the fact that experiments with this kind of fuel have not always been successful and it also was stated that just as the foundryman is an individualist in the matter of practice, so he is in the matter of the use of coke. Mr. Kirkpatrick warned the foundrymen that whether they liked it or not, that within 15 or 20 years they all would be using by-product coke as he pointed out that beehive production was constantly tapering off and that in the natural course of events the old method of making coke would vanish.

The meeting was largely attended and the discussion following the paper was spirited and interesting.

"Repair of the German Ships" is the title of a booklet issued by the Wilson Welder & Metals Co., Inc., New York, which details the repair of the damaged machinery on the German ships in the New York harbor by the use of the electric arc-welding apparatus built by this company. Illustrations are included of many of the interesting welding jobs performed, as well as some of the German ships repaired in this way.

Avoiding Evils of the Cauliflower Pouring Head

Causes and Remedies for Excessive Gas Expulsion Explained—Experience Indicates Use of Deoxidizer as Good Practice in Nonferrous Melting

By R R Clarke

CERTAIN phenomena observed in every-day foundry experience may be accepted as proof of improper practice and a warning to correct the underlying evils before irreparable damage is done. Among them is the cauliflower pouring head, so-called because of the resemblance of the exposed surface of the metal, when poured, to the variegated surface of the cauliflower. If the molder, when pouring the metal, notices it work up from a plastic mass into a beaded dome at the head of the pouring gate he may consider it an ominous sign.

Many alloys exhibit this tendency, but it is less pronounced in new metal than in the alloys containing an excess of scrap. It is comparatively rare in alloys containing phosphorus and in those having a relatively high percentage of zinc. The combinations in which it has been least observed are those in which the constituents were as follows: Copper, 79; tin, 10; lead, 10, and phosphorus, 1. Copper, 89; tin, 10, and phosphorus, 1, and in the copper-zinc combinations containing from 75 to 86 per cent of copper. We have noticed it in those alloys containing a high percentage of tin and a low percentage of zinc, even when all the metals forming the combination were new. In pure copper, sand-molded, the appearance of the cauliflower head is not so pronounced as in the case of some alloys, the copper rising when in a more liquid state and consequently overflowing the edges of the gate, instead of assuming a beaded-dome shape. Of all the elements or alloys coming under our observation, copper has shown the greatest tendency to flow back when being poured into the molds. The cause, however, would seem to be identical in all instances.

According to the law of gravity, metals in a molten state should flow downward and, therefore, other forces must be at work when they rise in the pouring gate. This apparent reversal of natural law has a simple explanation: Gases are generated in the melting process, and in seeking escape, force the metal upward. The nature of the gases, however, has not been fully determined, but in the majority of instances they are supposed to be oxygen and sulphur gas. Foundrymen have come to recognize oxygen and sulphur as portents of trouble. Hydrogen and nitrogen also are considered sources of annoyance. Despite general opinion on the subject, however, it would seem reasonable to assume that responsibility for the evil in question is charged too frequently to the presence of oxygen. It is not the nature of oxygen to remain a gas in metal at high temperatures. The tendency of the gas is to unite with the metal and so form an oxide, particularly in the case of alloys containing strong oxygenating elements.

Indicates Porous Casting

The cauliflower pouring head nearly always indicates an extremely porous condition of the casting. The casting also may contain large cavities, making it unsuitable for use. But a distinction must be made between an unsound casting, as shown by the cauliflower head, and a sound casting in the making of which *bleeding* or *sweating* is noted. Most any casting, made from an alloy, when removed from the sand while too hot will show a certain loss of metal due to the sweating process. If a heavy pouring gate or riser be broken off below the surface of the metal while the metal is still hot, evidence of the flow-back of a portion of the metal which was tardy in solidifying also will be observed. Such loss of metal, however, is purely local in nature and is due to other causes than those which produce the cauliflower head. The *bleeding* of castings is a common occurrence and detrimental, but gate sweating, on the other hand, is less frequent and not to be so seriously considered.

The principal causes of an inordinate amount of gas expulsion may be stated, in the order of their importance, as follows:

Superheating the metal—keeping the metal unprotected for long periods in the furnace after it has reached the proper temperature.

Dirty and slaggy conditions of the furnace.

Using metals low in quality or those previously subjected to bad melting practice.

Poor grade of fuel.

The use of newly-lined and damp ladles.

Indiscriminate mixing of scrap.

Illogical combinations of metal.

Many times we have noted the cauliflower effect and all its related consequences proceeding from the superheating of metals. A representative case was that of a large tailshaft bushing for use in ships, weighing some 700 pounds and poured from the 88-10-2 combination of new metal. The metal was melted in a furnace of 1000 pounds capacity. Because the lining in another furnace gave way at a critical moment, the metal for the bushing had to be held until the other metal could be disposed of, and, in the diversion of attention, it was neglected. The result was a superheated metal, which while brought to correct pouring temperature by cooling, showed the most pronounced cauliflower effect in the pouring head and risers. This casting exhibited great porosity.

As to the second cause of gas expulsion, it might be considered a possible outgrowth of the cause already discussed. The higher degrees of temperature are difficult to control with the average equipment and facilities. The operator may bring the metal to a pouring temperature, reduce the volume of air and oil to what might appear to be necessary to maintain the constancy of the temperature, and yet he might miss the mark widely. That might have been the case in several instances we have noted, the cauliflower resulting from holding the metal too long, although there was nothing unusual at the time of pouring to indicate the fault. The cauliflower may also have been due to gradual absorption or decomposition. In either case, the result was the same. As an example: A heat was to be poured into large stuffing box glands made in halves. The metal was an 87-8-5 combination of copper, tin and zinc, and was held pending repairs to a breakdown in a trolley system. The first mold poured showed the defect and no more were considered, the metal being pigged and used, an ingot or so in each subsequent heat.

As to slag-polluted furnaces we have more than once noted the deteriorating influence of this condition, and we are quite sure of porosity being an attending evil. When the operator slags out his furnace under heat, allowing the slag to run or drip out of the pouring nozzle, he will, by

observing closely, always notice an excess of gas escaping in the pool. Examining this slag when cold-broken he will often find it full of small holes. More than once we have watched small portions of molten metal escape along with the slag, and even when it was not superheated we have observed strong agitation in it from the influence of gases. High temperature could have caused some of this effect, but it could not have caused it all and so repeatedly. A slag-developing temperature is commonly reached, but in an ordinarily clean furnace we might say it is seldom productive of a porous condition, originating from the presence of gas. It is only when the furnace is permitted to become abnormally dirty that the evil is developed. Incidentally, cleanliness of furnace is 50 per cent of the requirements in good melting practice.

When 1000 pounds of an 88-10-2 combination are melted, 880 pounds of copper are melted first. On the surface of the melted copper there frequently will be a sheet of slag. Some molders believe this is a good protective coating, but we believe it retards melting and is a menace to quality. If the slag is permitted to remain when the tin and zinc are introduced it interferes with the proper combination of the metals and invariably admits the possibility of a bad condition of the metal.

We have heard it said that metal-attacking gases can come from furnace linings. That we regard more as a matter of opinion and the quality of the lining, rather than a scientific fact; but if it is true, it is well to remember that slag can and does originate from the same source. Various methods and preparations are used to break up surface-riding slag. We know of no method less expensive and more efficient than a good-size shovelful of charcoal thrown on the metal, the mass to be stirred well as the charcoal is heated to a bright color. The dioxide gas then skims off clean, when more charcoal may be thrown on to prevent further formation. In what way slag and gas-charged metal may be associated we are not certain; we only know that our oil-melting experience has been such as to convince us of connection between them.

From the cause next in order, that of poor quality of metal or metal previously melted under bad practice, several important conclusions might be drawn. First, it might be taken for granted that no matter what the quality of the metal might be it is susceptible to damaging influences; second, it might be considered that it is a difficult and uncertain task to get metal, once ruined, back into proper condition for use; third, it is reasonable to suppose that in the ruined metal there are entrapped gases which are not eliminated in the remelting process, the danger of porosity thus being extended; fourth, we cannot escape the conclusion that metal of poor quality has a deteriorating influence on metal of good quality when they are combined, rather than the good metal improving the bad.

Quality of Fuel is Important

To illustrate the latter point: We once obtained some pigged copper from a reliable reduction company. The copper had been ruined in pigging. We tried to improve it in every possible way, but failed until we consigned it to phosphor bronzes, when it was improved by a slight increase in the amount of phosphorus used.

The effect of the quality of fuel used in the melting process is well known to be far-reaching. In pit melting, the effect of high-sulphur coke, for instance, is of common knowledge. In the use of oil and air, the grade of oil has been given less attention and its effect is not so well understood. We have noticed that a grade of oil which will delay the melting period or generate gases that float on the molten surface, or that will develop slag and dross, will always cause trouble. This matter of clean, complete combustion of the proper quantities of oil and air is important; it is one of the first principles of good melting and requires close study and attention to details. Perfect combustion eliminates waste and improves the quality of the casting. We have observed a decided tendency toward the escape of gases in the sprue head when fuel of low quality was used.

Effect of Damp Ladles

As to the next cause, the use of newly-lined and damp ladles, two explanations might be offered. First, something in the lining material might be responsible, and, second, a gas arising from the decomposition of water and generating from either one or both of its constituent elements might be the source of the trouble. As to the first, it appears to be an inference far-fetched. That some lining material could cause the trouble is reasonable to assume, but that all lining material should cause it is doubtful. Our ladles are lined mostly with a patching compound, although we frequently use blue clay, fire clay and other materials. Between heats we paint the linings, either with a clay wash, red talc or plumbago mixed with molasses water. The trouble occurs invariably when newly-lined and damp ladles are used, and even when the paint on ladles has not been thoroughly dried. We are inclined to exempt the character of the lining material and hold the fact of dampness accountable for the difficulty. Only the metal poured from the first ladle produces the effect referred to, indicating that the dampness has been dispelled by the heating. This would seem to indicate that water-generated gas is responsible and not steam, which could not survive the high temperature and be incorporated in the metal. The inference is not altogether absurd that hydrogen gas is at least an active if not the most active agent. This gas has been shown to be present among the gases expelled from the metal.

Causes next in order are similar in nature and may be considered as one. The indiscriminate mixing of scrap always introduces the possibility of an illogical combination of metals. Certain metals were never intended to mix, and to analyze the effects of illogical combinations would be outside the scope and purpose of this article. We can only refer to several typical examples of the result of using such combinations. In our earlier experience as a molder we remember a brand of bearing metal which invariably showed an extreme case of metal expulsion in cooling and made a porous casting. In every mold poured the tendency toward expulsion in cooling was so strong as to heavily fin the top of the casting with a brittle metallic substance and to part the halves of the mold.

Air ports on ships are framed with yellow brass castings which do not require a particularly high grade of metal. Not long ago we melted for this purpose some scrap poorly mixed and containing aluminum. The result was badly raised spue heads and decidedly porous castings.

Superheating of the metal being the most frequent and pronounced cause of the cauliflower head, the question might be asked: "Is there anything in the molten mass to indicate its gaseous state?" In the case of superheating and dampness of ladles the metal in the ladles shows a certain degree of agitation, but it is no more pronounced than the mere fact of heat or dampness would account for. In metal polluted with slag there also is evidence of unrest, but that also could result from a cause not associated with the presence of gas.

Since metal heated to a certain temperature, under certain conditions will result in a porous casting and since this condition results more often

when air and oil are used, it is at once apparent that the temperature of the metal is an important consideration in nonferrous melting. To what extent the temperature can be raised and maintained and evil consequences still evaded is a question of no mean significance. In the case of an 88-10-2 combination, Carpenter found that up to 1225 degrees, Cent., the evil did not appear, but at 1400 degrees it was conspicuously in evidence. The combination, however, is one in which the active reagent is low and it is such that suffer the most in this respect.

The greater the bulk of the metal the more pronounced is the cauliflower. In light, thin castings, the cauliflower may be observed at the gate, but the casting may still escape the consequence. This, however, is more a matter of mechanical influence, brought about by rapid solidification.

How Trouble May be Avoided

Several remedies may be suggested for the evil. Among them the simplest and most effective is to maintain carefully the correct pouring temperature. Metals that have been superheated will make better castings if the temperature is reduced to normal at the time of pouring. This rule, however, has exceptions, and occasionally the precaution fails. The failure in such cases is closely related to the bulk of the casting and a complication of causes.

Summing up a technical discussion of matters affecting the 88-10-2 alloy, Carpenter and Elam concluded that "provided the metal is allowed to cool in the crucible, however much it may have been overheated, it is obtained quite free from blowholes." In explanation, the authors state that this applies to an alloy made for the first time or to metal previously cast which is remelted. Literally, this must be taken to apply to all cases of the same metal combination, since all alloys are either those of "first making" or those at some time "first made" and afterward remelted. That is our impression of the explanatory remark, unless the authors observe the fine distinction between metal as an element and alloys as a combination. We are inclined to question the practical stability of this experimentally derived conclusion. Further on the authors state: "From the above observations it will be evident that the nature of the copper and the various impurities in it have little or only a minor influence. The temperature, however, is all-important and provided this can be regulated and controlled there should be no difficulty about always obtaining good castings."

By "the temperature" we presume the authors mean "the *pouring* temperature." We do not know to what extent the experiments covered the different brands and kinds of copper and its impurities as relatively differing in high and low grades of new material, in scrap, etc., but whatever that extent, we feel convinced that every day practice would not justify a conclusion so absolute.

There is no doubt that any 88-10-2 combination heated to or above 1400 degrees, Cent. and reduced to 1200 degrees in pouring will have better chances than that poured at the higher temperature. But there also is no doubt that all such combinations under similar conditions will not always yield sound castings. The point we make is that while pouring temperature is a controlling factor it is not an absolute determinative.

Consider the case of a heavy riser, attaching to some high and heavy portion of the casting and enlarging to great bulk in the riser-head. Before rising to the head of the riser, the metal has to descend the pouring gate and fill the mold, and is always much lower in temperature than that filling the pouring gate at the time the pouring is finished. More than once we have seen the metal shrink in the pouring gate head, naturally and normally, yet in solidifying rise in the riser to the cauliflower effect. That could not be charged to an increase in the temperature of the metal in the riser gate.

Addition of Zinc as a Corrective

So far as we have been able to discover, the remedy for the gas evil in metal is similar to that for correcting the oxide evil. This is no concession of a strict identity between them, but a recognition of the same cure for them. In any high-zinc combination, abnormally superheated, it is common knowledge that the zinc content is considerably below the introductory figure. Even in low-zinc mixes such as 88-10-2, 85 and three 5's, 87-8-5, etc., the condition prevails. Therefore, we are not adverse to the opinion that the continued superheating of the metal, after the zinc has burned low, has something to do with the gas. We have found that to add a small percentage of zinc to those alloys containing zinc, when in the ladle and just prior to pouring, is a very efficient method of reducing the difficulty. The amount of zinc to be added is about that which would restore the alloy to its original formula. The zinc is immersed in the bath and the metal thoroughly stirred. In addition to this, we always throw crushed charcoal in the ladle bottom and pour the metal from the furnace over it, hoping that the carbon gas will aid in reducing the gas of the added metal. We do not add zinc to the 88-10-2 mixture but, instead, a trace of phosphorus. We do the same thing to the phosphor alloys when the case seems to warrant. In the higher-zinc mixes we make no attempt to add phosphorus.

Melting and Casting Copper

Melting and casting pure copper is difficult and we have never been able to obtain assured results without the addition of some regent. There always has been a tendency toward expulsion and consequent porosity. Correctives of the evil are zinc, phosphorus, silicon, boron, carbide, magnesium and titanium.

In introducing any reagent two things have to be generally considered: First, the effect on conductivity, and, second, the effect on physical property. Phosphorus hardens the alloy and lowers conductivity, while zinc toughens it slightly, changes its color and also reduces its conductivity. For general purposes, silicon will be found an advantage, since neither the physical property or conductivity seem to suffer greatly from it. The inference that a deoxidizer also is a remedy for the gas evil gains strength from the scientific deductions of Merica. In discussing the matter as related to copper he has this to say: "Although good castings can be made with copper alone, modern practice in the casting of copper favors the use of a deoxidizing agent added to the molten copper before pouring; the deoxidizer removes the oxygen and prevents also either the gas absorption or its later disengagement during solidification." Every-day foundry experience can have little to detract from that statement.

In considering the 88-10-2 alloy we would call attention to the serious evil of pouring at a temperature too low to be sure of escaping one too high. When poured too cold, abnormal shrinkage and an excess of dross result. The shrinkage is especially severe in bulky castings. A still further evil arises from the wave-like rolling of this metal in motion at low temperatures. These waves would appear to be separated by a thin film which tends toward partition and result in open sutures in the casting. Especially does this appear when the mold is of expansive surface.

In conclusion we express our conviction that the cauliflower pouring gate head is an evil originating principally in practice, and that notwithstanding all agencies for correction the control of cause is by far the best

Foundrymen Discuss Nonferrous Alloy Problems

Winter Meeting of the Institute of Metals Division of Mining Engineers Considers Metallurgy of Brass Casting Manufacture

A FEATURE of the annual convention of the American Institute of Mining Engineers, held at New York, during the week of Feb. 17, was the one-day meeting of the Institute of Metals division of this organization. The sessions were attended by approximately 100 nonferrous metallurgists and brass foundrymen. W. M. Corse, who was elected chairman of this division at Milwaukee, presided. To make its name more closely define its enlarged purpose, announcement was made that the name of the parent organization had been changed to the American Institute of Mining and Metallurgical Engineers.

Among the interesting and practical papers of the meeting was that presented by P. E. McKinney on "Manganese Bronze." He said that the production of manganese bronze from scrap metals is a particularly important problem at this time in view of the likelihood that during the next few years of reconstruction, the country will be flooded with many by-products and much scrap resulting from the extensive operations carried on during the period of the war. The composition of the average manganese bronze, he said, follows: Copper, 57 to 59 per cent; zinc, 38 to 40 per cent; iron, manganese, aluminum, tin, 0.25 to 1 per cent; lead, 0.10 to 0.50 per cent. This composition, Mr. McKinney said, clearly shows that there is no necessity for the use of high grade raw materials, provided methods of manufacture can be devised to produce the proper refinement of the metal for the finished product.

Charles W. Pack, chief chemist of the Doehler Die Casting Co., Brooklyn, in a paper entitled "Die Castings and Their Application to the War Program," attacked the theory that all blow-holes in die castings are caused by air coming in contact with metal. He mentioned other causes of blow-holes. In some cases, for instance, where the gate is narrow, the gate may become chilled before the inner portion has been filled, in which case blow-holes result. A similar effect is produced if the metal is too cold at the time of casting. In many cases blow-holes result from shrinkage. During the past four years, Mr. Pack said, the most important advance in the art of die casting has been made in the perfection of the process for die casting aluminum and its alloys.

The need of a campaign of education whereby the employer may safeguard the health of his workers was pointed out in a paper on "Standards for Brass and Bronze Foundries and Metal-Finishing Processes," by Lillian Erskine, investigator of occupational diseases for the New Jersey bureau of hygiene and sanitation. She said that the chief handicap to the conservation of health of the brass founders' employes has been the fact that, unlike the iron founder, his business could be profitably carried on in almost any small and unsanitary quarters. The English requirement of 2500 cubic feet of air per brass worker engaged in sand casting and of 3500 cubic feet per worker in rolling mill casting, it was stated, is a reasonable standard for structural dimensions. Adequate lighting calls for the provision of window and skylight area on a basis of 40 per cent of the floor area.

A minimum height of 15 feet in the side walls is essential for free natural ventilation. The adequate draft for pit furnaces, she said, is governed by the diameter and height of the chimney and the number of fires it is designed to carry. Five fires or less call for a minimum stack diameter of 18 inches; 30 fires, 38 inches; and 40 fires, 45 inches. Generally speaking, the height of the stack should be from 20 to 25 times the diameter. In reference to hoods, it was said that its area should equal the area occupied by the battery of fires and the pit and its lower edge should not be more than 6 feet 3 inches above the floor level.

In a paper entitled "Notes on Electric Furnace Problems," by J. L. McK. Yardley, general engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., pointed out two general classes of problems in connection with electric furnaces. These include matters relating to the best utilization of the electrical power in the furnace and those connected with the bringing of electrical power to the point where it is to be utilized. Mr. Yardley presented formulas and analyses he had compiled during his tests and experiments with electric furnaces.

Zay Jeffries, Aluminum Castings Co., Cleveland, discussed the progress that has been made in recent months in determining the effect of temperature, deformation and grain size on the mechanical properties of the metals.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Hardening Copper

We are interested in hardening copper and will appreciate any information regarding this process that you can furnish us.

It must be understood that whenever copper is *hardened* it ceases to be copper and becomes an alloy of copper with the element that is used to produce the hardening effect. It is possible to make copper harder than it is naturally, and not to injure its characteristic color, but this must not be taken as indicating that the copper is not an alloy and is *hardened copper.* Copper naturally is a soft metal and the only way that it may be hardened is by hammering to increase its density. Cast copper can be hardened by forging until it is as hard as bronze, but it immediately becomes soft again when it is heated. Hardening copper by the addition of other elements always robs it of its property of electrical conductivity; therefore, if the castings are to be used for electrical purposes this should be borne in mind.

Copper can be hardened by iron without changing its color. The best way

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

FORMULAS FOR THE BRASS FOUNDRYMAN

Parson's Manganese Bronze

In producing Parson's manganese bronze, the following alloy, used as a *hardener*, first is made:

	Pounds
Norway iron clippings	36
Ground 80 per cent ferromanganese	8
Tin	20

A furnace capable of attaining a high temperature is required to melt the *hardener* alloy. The iron and ferromanganese must be liquified together, when the tin is added. In some cases the tin first is melted and poured into the liquid iron and manganese, but it is preferable to add the tin gradually in the solid form. This alloy should be run into thin strips, to facilitate making the small weights required. It is frequently shotted, but this should never be attempted without further equipment, as it is a dangerous operation.

For Parson's bronze, melt the following in the proportions given:

	Pounds
Copper	56.00
Zinc	41.50
Hardener	2.50
Aluminum	0.50

Melt the copper first; add the hardener; superheat a few minutes; stir thoroughly; add the aluminum and cool the metal with bronze from previous heats. If none is on hand, reserve a small amount of copper for this purpose; cool until the metal while nicely liquid, is not what would be considered hot; then commence to add the zinc, charging a little at a time at first and adding it finally as rapidly as the alloy will dissolve it without becoming chilled. When the zinc addition has been made, stir thoroughly, do not superheat, but pour into ingots. Melting for high elongation is accomplished by melting again.

The analysis should be approximately as follows:

	Per cent
Copper	57.10
Zinc	40.50
Iron	1.20
Tin	0.70
Manganese	0.10
Aluminum	0.40

FORMULAS FOR THE BRASS FOUNDRYMAN

Manganese Bronze C

Used for propellers and castings that must be strong and ductile, manganese bronze *C*, specified by the Philadelphia navy yard, has the following analysis:

	Per cent
Copper	55.00
Zinc	37.00
Ferromanganese, 80 per cent	4.00
Aluminum	1.25
Norway iron	1.75

This alloy is unlike ordinary manganese bronze because of the absence of tin and the high content of iron, manganese and aluminum. It is a difficult alloy to mix unless the exact method of making the *hardener* is known. This hardener is different than the one employed in producing ordinary manganese bronze, but can be made satisfactorily by melting 25 pounds of copper under a cover of charcoal; when very hot, add 2½ pounds of iron in the form of thin sheet clippings, such as stove pipe iron, and stir thoroughly to dissolve the iron. Charge the iron loosely in small pieces to prevent fusion and when melted add the aluminum, and stir again. When the copper and iron have attained a high temperature, charge the additional 24 pounds of the 49-pound charge. When this copper has been melted, add 10 pounds of *B* grade manganese copper; melt and add 37 pounds of zinc. Stir thoroughly, remove from the furnace and pour into ingots.

For making the castings, melt the ingots and add 1.5 per cent of zinc to compensate for volatilization. Use heavy feeders, gate from the bottom, and do not shake-out the castings until they have cooled to their natural bright, greenish yellow color.

The pouring temperature is from 1790 degrees to 1810 degrees Fahr.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

is to melt the copper under charcoal and when hot, add one or more percent of yellow prussiate of potash; since the potash salt is so expensive, probably the sodium salt could be substituted. This salt adds iron, and the iron can also be added in the form of tin plate with a flux of calcium chloride. Ferrosilicon also hardens copper without changing its color, and phosphorous will harden it, but should be used in small quantities.

Antimony, also hardens copper, but makes it brittle, and arsenic has the same effect; with 40 per cent arsenic the alloy is white, hard and brittle. Copper can also be hardened by the addition of calcium, but the alloy cannot be poured into sand molds with an assurance of obtaining sound castings.

Overcoming Leakage in Hydraulic Bronze

We have experienced considerable difficulty in making bronze castings, known as heater rings. These are wide and have hollow walls in which water circulates and is heated. We are using old scrap valves for the metal, but the castings are spongy and leak when tested to 100 *pounds hydraulic pressure. This leakage generally occurs in the lower part of the casting in the drag. The castings weigh from* 55 *to* 110 *pounds and the walls are* 5/8*-inch in thickness.*

The castings leak because they are not sound, but are full of dross and probably have other imperfections. The mixture being all scrap contains more dross than new metal and it may also contain impurities such as aluminum, or it may be high in zinc. Such material is unfitted for hydraulic castings because it drosses badly and the dross lodges between the crystals of the metal and allows water to seep through under pressure. If the castings can be made sound when using this scrap metal it will be just as good as new material, but if this cannot be done, it will be more costly to attempt to use this scrap than to make an expensive new alloy, on account of the high percentage of bad castings produced. An attempt might be made to clean the scrap metal by the addition of 1.25 per cent of 15 per cent phosphor copper. Magnesium also has a good reputation as a deoxidizer for hydraulic castings; about 1½ ounces should be used to 100 pounds of metal.

If new metal is employed, it would not pay to use a mixture cheaper than the following: Copper, 82.75 per cent; nickel, 2 per cent; tin, 5 per cent; lead, 5 per cent; zinc, 5 per cent and phosphor copper, 0.25 per cent.

The following alloy, however, is by far the best: Copper, 90 pounds; tin, 6 pounds and 5 per cent phosphor tin, 4 pounds.

Preventing the Segregation of Copper and Lead

Kindly inform us how to make a mixture of 50 *per cent lead and* 50 *per cent copper. We have made some ingots of this composition, but the lead sweats out when they are remelted.*

The reason the mixture fails to form a homogeneous mass is because lead and copper do not alloy together in more than very small percentages; consequently, when these metals are melted together, they have a tendency to separate on cooling and the lead, being heavier, sinks to the bottom of the cast.

To form mixtures of lead and copper, some other element has to be added and this is usually sulphur; about 1 per cent of sulphur is used, which is added to the copper. Sometimes the ore, galena, is added to the sulphur. There are hundreds of ways of holding the lead in solid solution in the copper, and most everyone has a way of his own. Local conditions controlling the melting have much to do with the success or failure of efforts in this direction, and this is the reason why methods differ. When pursuing a good method of holding in the lead, the second melt of the metal is better than the first. Since in this instance, failure attends the second melt, we assume that no sulphur is being used in connection with the alloying. It would be advisable to use roll sulphur, and to add 1 per cent to the metal, putting in 0.5 per cent when the copper is melted and the balance when the lead has been added.

An Aluminum Weld Accidentally Effected

We are sending you a section cut from an aluminum wheel, which has a perfect aluminum weld on the rim that was produced accidentally. This wheel was piled with some others on the floor of our foundry near the ingot molds used for surplus metal. While pouring some excess metal into one of the molds, the pot slipped in the shank and spilled a small amount of metal on the floor. Some of this splashed onto the wheel and was welded to the casting. In view of the difficulties experienced in our oxyacetylene shop in getting good aluminum welds, this case of spilled metal welding so thoroughly seems quite a remarkable freak. The metal was not very hot, but was about the right temperature for pouring the pulleys; in fact a floor of pulleys had just been poured from the pot.

The welded wheel section certainly is interesting and to account for this phenomenon we imagine that the wheel had recently been removed from the mold and was quite hot and that the splash of aluminum struck it *en masse* and burned on. However, if the wheel was cold, then the weld becomes almost a miracle, and we doubt very much whether any attempts to duplicate it would be successful. It proves, however, that aluminum can be burned-on and that a good union can be made. To insure success in welding aluminum, the casting should be hot and the burned spot should be so exposed that the molten metal can be thrown directly onto it to cut into the solid metal and form a strong union. The sudden splash must have removed the film of oxide from the surface of the wheel as in soldering this must be removed.

Mixtures for Aluminum Pistons

We have an inquiry for an aluminum alloy for pistons which should be as strong, if not stronger than cast iron. What is the weight of this metal per cubic inch?

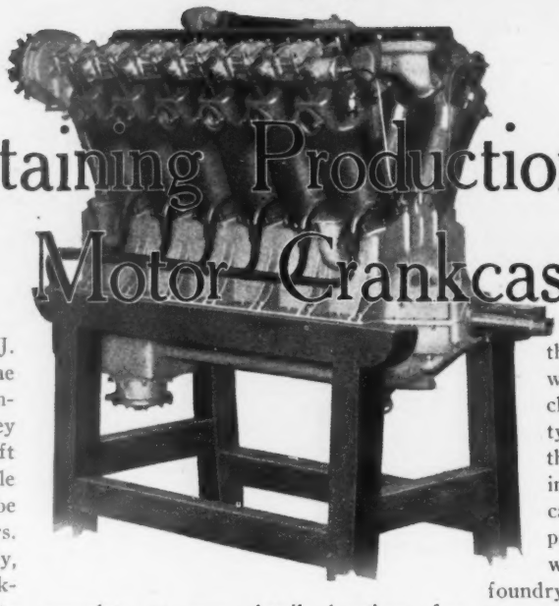
The standard aluminum alloy for automobile castings follows: Aluminum, 92 per cent and copper, approximately 8 per cent. This alloy has a tensile strength as high as 20,000 pounds per square inch; elongation in sand castings ranging from 0.5 to 1.5 per cent; specific gracity of 2.8; Brinell hardness of 50 to 55; shrinkage of 0.186 inch per foot and its weight per cubic inch is 0.10 pound.

A stronger alloy contains aluminum, 82 per cent; copper, 3 per cent and zinc, 15 per cent. The tensile strength of this alloy may reach 26,000 pounds per square inch. Its specific gravity is 3.1; Brinell hardness, 60 to 65; shrinkage, the same as the former alloy and its weight per cubic inch is 0.11 pound. Both alloys present no unusual sand casting difficulties.

Mixtures for Bearing Metals

Kindly furnish us with a number of bearing metal mixtures.

The mixture largely depends on just how the bearing is going to be fitted to the surface it must sustain and whether the speed of the shaft is high or low. When a bearing is not to be closely fitted, but must conform to the shaft, the alloy must possess sufficient plasticity to meet this condition. In such cases, an alloy consisting of copper, 65 per cent; tin, 5 per cent and lead, 30 per cent, is successfully used. Another alloy that will conform to the shaft is copper, 77 per cent; tin, 8 per cent and lead, 15 per cent. Another good bearing metal consists of copper, 80 per cent; tin, 10 per cent and lead, 10 per cent. For an accurately fitted shaft, well lubricated and run at high speed, an alloy of copper, 86 per cent; tin, 11 per cent and phosphor-copper, 3 per cent, frequently is used to advantage.



Attaining Production On Liberty Motor Crankcase Castings

WHEN J. G. Vincent and E. J. Hall left Washington on June 4, 1917, after days of planning and close study, they carried instructions from the aircraft production board to build 10 sample engines. These were destined to be the first Liberty type aircraft motors. Preceding them by a few hours only, were skilled layout men from the Packard plant hastening back to Detroit to complete at once detail drawings for the two *long-time* parts involved—the cylinders and crankcases. The drawings for the aluminum crankcase, upper and lower halves, were near enough complete on June 13 to allow the pattern work to start. By the utmost concentration and the combined efforts of engineers from the Cadillac, Dodge and Packard motor car organizations the first sample motor, in this case an 8-cylinder model, was completed and shipped to Washington for test on July 3. Other samples followed rapidly, and on Aug. 25 the first official test of the 12-cylinder Liberty motor was completed.

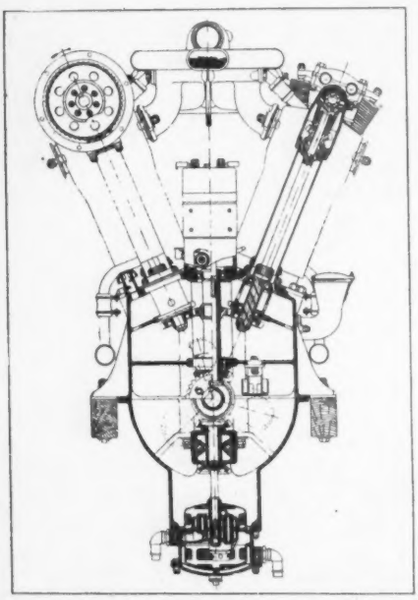


FIG. 1—SECTIONAL REAR ELEVATION OF LIBERTY MOTOR SHOWING CRANKCASE

Rounding the Corner to Production

This marked the completion of what might be termed the purely experimental stage of America's greatest single mechanical offering to the war. From that time forward, production became the problem. The 12-cylinder model was accepted as the most practical for the needs of the initial program, which did not include any machines of the single seater chasse type. As may be gathered from the desire of the designers to get immediate action on the crankcase of the first motor, this particular part presented problems which were a challenge to the foundrymen called upon to make them. The crankcase is in two parts, of

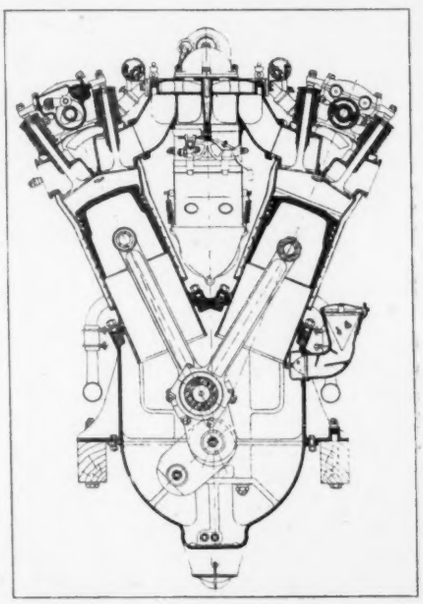


FIG. 2—TRANSVERSE SECTION THROUGH CYLINDERS AND CRANKCASE

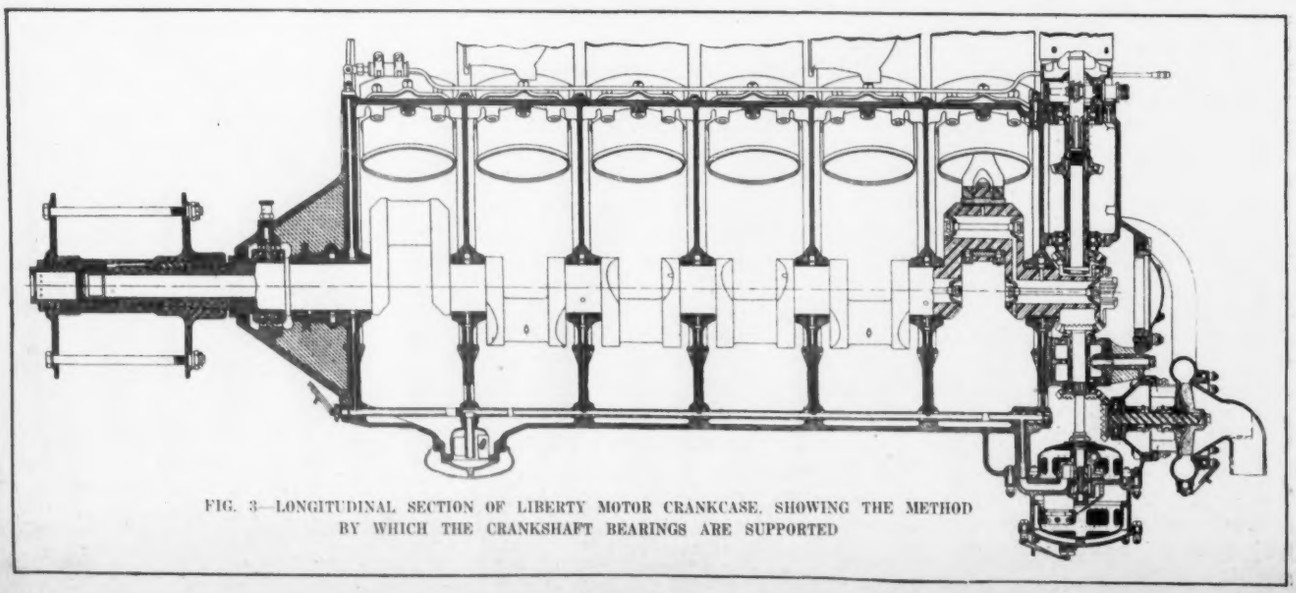


FIG. 3—LONGITUDINAL SECTION OF LIBERTY MOTOR CRANKCASE, SHOWING THE METHOD BY WHICH THE CRANKSHAFT BEARINGS ARE SUPPORTED

the deep box section type. The upper and lower halves are lapped together and firmly anchored by bolts through the flanges and long through-bolts centered integral with the crankcase castings at both ends. The individual steel cylinders extend through the upper half of the crank-case, as may be noted from Figs. 1, 2 and 3. The main bearings are supported between the upper and lower halves, necessitating an aluminum alloy of considerable strength and toughness. A tensile strength of 18,000 pounds per square inch was required. Furthermore, the entire absence of sponginess or blowholes was imperative. In his report on the Liberty aircraft engine, J. G. Vincent, vice president and engineer of the Packard Motor Car Co., Detroit, and one of its principal designers, says:

"In my opinion the design of this crankcase had a great deal to do with the satisfactory operation of the Liberty engine, and I know that no other type could be designed anything like as light and still stand up."

Credit Due the Foundry

In this design, trust was placed in the ability of American foundrymen to make the crankcases structurally perfect. The varying sections, sharp angles and other considerations contributed to make the difficulties marked. Liberal provision for risers was necessary to provide sound metal. Chills were required at dangerous sections; and accurate coreing alone insured the proper location of spaces and cylinder openings.

The Aluminum Castings Co., Cleveland, with plants at Detroit and in other cities, was among the firms called upon to produce crankcase castings in quantity. The handling of the work, particularly the molding of the upper half of the crankcase, reflected great credit upon the management of this foundry.

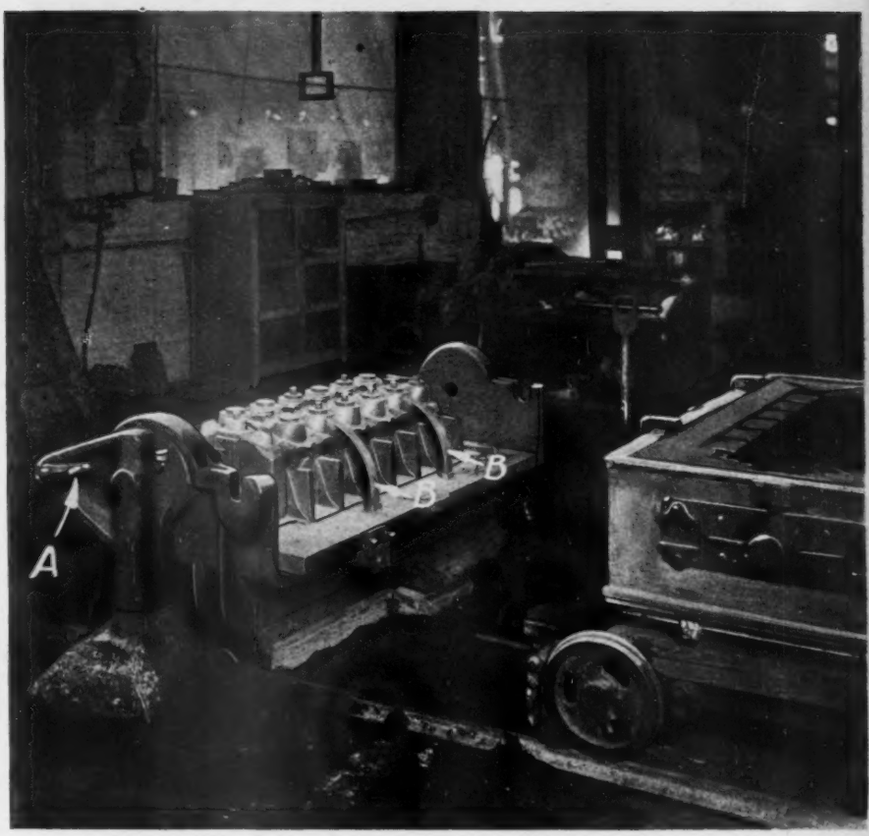


FIG. 4—PATTERN FOR TOP HALF OF CRANKCASE WITH HORN RUNNER PATTERN IN PLACE ON JOLT TABLE OF ROLL-OVER MACHINE

FIG. 5.—TUCKING IN THE FIRST SAND PLACED IN THE ALUMINUM FLASK PREPARATORY TO FILLING AND JOLTING

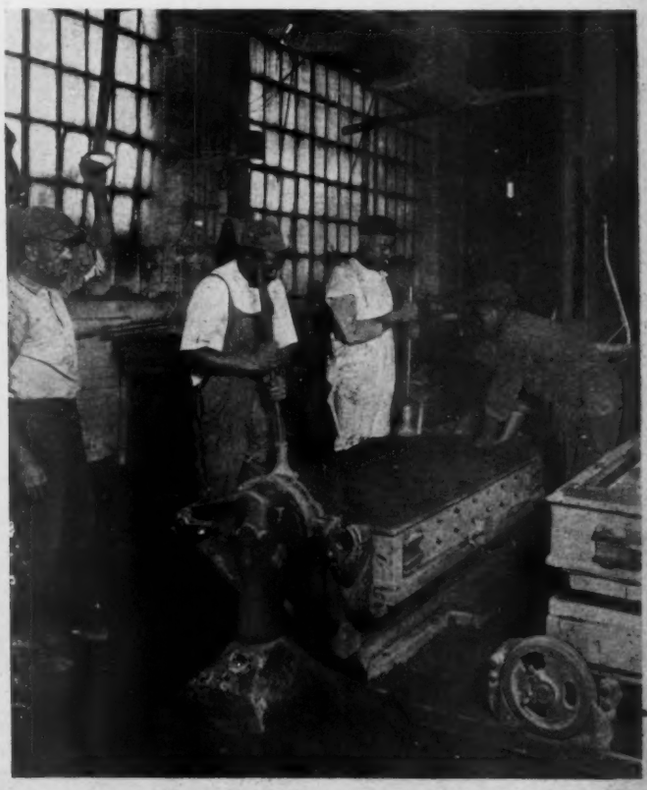


FIG. 6—JOLTING COMPLETED, THE EDGES ARE HAND RAMMED BEFORE PLACING THE BOTTOM BOARD AND ROLLING THE MOLD OVER

In the early stages of the work, before production was fully attained, it was found possible to ram by hand, 80 or more molds with three shifts per day. The Cleveland plant of the company, however, early established a molding system based upon the molding machine shown in Fig. 3. This system included the production of all drags upon this machine, and the copes on a jolt, stripping-plate machine. The assembly and pouring, a few at a time, followed upon the molding floor. The production attained with this layout reached as much as 102 molds in nine hours, with an average of 85 molds in the same period maintained continuously.

FIG. 7—CORES ARE SET AND THE MOLD IS CLOSED ON THE POURING FLOOR—NOTE THE LIFTING ARBORS AND THE CORE PRINTS WHICH SERVE AS LIFTING PLATES TO HOLD THE GREEN SAND CORES

The machine shown in Figs. 4, 5 and 6 is a direct-draw, roll-over jolt-rammer, built by the Cleveland Osborn Mfg. Co., Cleveland. It has a 70 x 29-inch table, a 12-inch roll-over cylinder and a 9-inch jolt cylinder. An adjustable draw valve permits speed regulation in drawing the pattern. In this manner the lift is started slowly and as the pattern is freed from the mold the speed is increased until the full lift of the table is reached. Although the machine will handle up to 2000 pounds, this job did not require the full capacity as aluminum flasks, patterns and pattern plates decreased the weight of the load on the jolt table.

Integral with the machine is a run-out track and car, shown at the right in Fig. 4. This car has an automatic leveling device by which the bottom board is brought to an even bearing. When the table is rolled over it is locked in place. The handle of this locking device is shown at *A*, Fig. 4. This holds the table in rigid alignment with the receiving car. The table then is lowered until the mold rests upon the car, the clamps are released and the pattern is drawn.

The leveling feature on the car table is effected by means of four short columns supported upon springs. These in turn operate a series of links with a central fulcrum connected in pairs to a central shaft. This shaft is connected through a locking joint to a handle by means of which all the four support columns are locked when they come to a firm bearing against the bottom board. The receiving car, in addition, is provided with scrapers at both sides of each wheel which serve to remove any sand or other obstruction from the track, and wheels.

The pattern used for the top half of the crankcase is shown bolted to the table on the machine in Fig. 4. In molding, the flask was placed and clamped to the machine table. Facing sand then was dropped from one of the overhead hoppers and tucked by hand, as shown in Fig. 5. Backing sand next was discharged from the second hopper, and the mold was jolted from 18 to 20 times. Experienced aluminum foundrymen were of the opinion that machine-molding would produce hard molds which would not allow the gases to escape as freely as was desired in this class of work. To prove this point one was jolted continuously for several minutes, and it was found that although a hard face was produced, that back of this the sand was not packed closely. The casting poured in this mold was equally as good as those made on molds jolted 18 to 20 times, as was the usual practice.

When the jolting was completed, the sides of the mold were rammed by hand and the bottom board was placed and clamped. The table then was elevated, the mold rolled over and lowered upon the receiving car, the pattern drawn and the mold on the car was pushed from underneath the machine. The patterns for the horn gates shown at *B-B*, Fig. 4, were removed at this stage. These were made to a perfect radius, so that in drawing them they slipped easily from the mold on a curved path. The drag then was ready for the molding floor.

The copes were simple. Only the risers and the long-stop runner, shown at *C*, Fig. 8, were carried in the cope.

Green sand cores were used. These, however, were supported on 1½-inch dry sand core prints which served as lifting plates by which to handle the cores. In molding the cores, a plain jolt machine was employed. The previously prepared core prints were placed in the core box on the machine, and removable arbors with handles were set before the cores were rammed. When the cores were set in place, these arbors were removed. The prints made the openings for the cylinders, as may be

noted from *D*, Fig. 8. The box sections of the crankcase were carried in the cores.

The method of gating and the risers employed may best be understood from Fig. 8. The molds were poured two up, with two stop runners at the opposite sides of the mold. These stop runners connected through the horn gates mentioned, to the bottom of the mold at four points. Most of the 28 main risers extended to the bottom of the mold, although some of them connected with the transverse walls or box section division webs of the crankcase. The four risers shown at *E*, Fig. 8 did not extend to the surface.

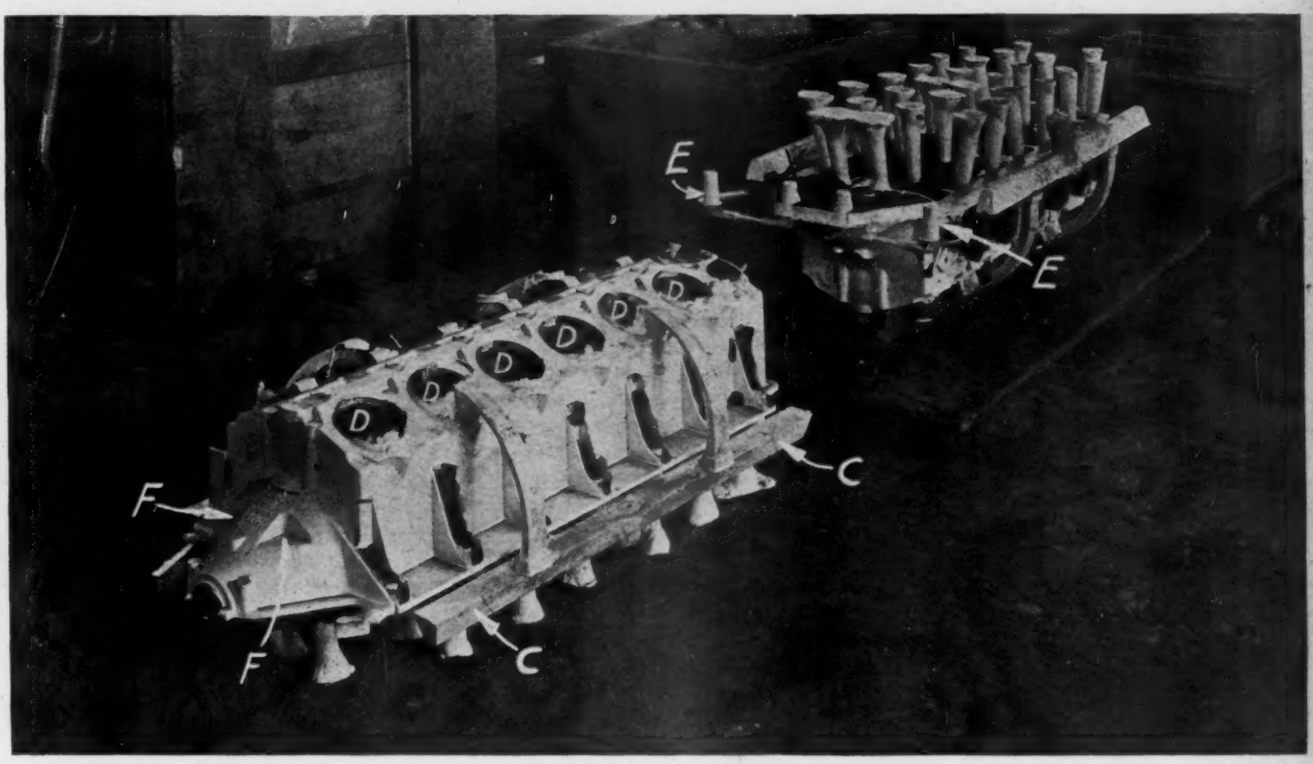


FIG. 8—TWO CASTINGS AS SHAKEN-OUT—AMPLE RISERS AND THE ARRANGEMENT OF RUNNERS AND GATE ASSURE A DENSE SOLID SECTION THROUGHOUT THE ENTIRE CASTING

Chills were used in the hollows at *F*, which were provided to give a bearing to the through-bolts connecting this half of the crankcase with the lower portion. They also were used at other points, notably along the section between the two lines of openings where the cylinders enter the crankcase.

Matthew Addy Co. Celebrates Sixtieth Anniversary

Sixty years of continued business activity was celebrated by the Matthew Addy Co., Cincinnati, at a dinner given at the Queen City club, Jan. 29. Men prominent in the iron industry throughout the country gathered to observe the occasion. The company originally was founded in 1859 under the name Addy, Hull & Co. to deal in peanuts and cotton from the South. C. H. Domhoff, who was identified with the company for 24 years from 1870, related the interesting development of the firm. After the civil war the small Shelby furnace in Alabama was rebuilt and Addy, Hull & Co. became its sole agent. The output at that time was from 14 to 15 tons per day. This was a superior quality charcoal iron used primarily for car wheel castings. This iron was shipped by rail to Cincinnati and retailed to some of the early users, including the Bass company, Ft. Wayne, Ind.; Barney & Smith, Dayton, O., and the McMillan foundry, now a part of the American Car & Foundry Co., Detroit. Later, Addy, Hull & Co. assumed the sale of the production of other furnaces in the Lehigh valley. This was mainly charcoal iron made in small stone stacks which produced never more than 25 tons per day.

In 1874 the pig iron business had developed until it became expedient to sell the cotton and peanut trade. Accordingly, the sale was effected and the company moved into offices in the banking district of Cincinnati. Henry M. Warren was then admitted to partnership. Soon after, failing health led Leverett R. Hull, the junior partner in the firm, to sell his interest. The firm then became Matthew Addy & Co. In 1881, C. H. Domhoff became a junior member of the firm. Mr. Domhoff withdrew from the partnership in 1894 and James A. Green, now president of the company, entered its employ. With the death of Matthew Addy the firm continued as the Matthew Addy Co.

James A. Green presided as toastmaster at the anniversary dinner. He was assisted in his duties as host by the other officers of the company, who include B. N. Ford, A. Burt Champion, R. M. Lambert and W. W. Hearne. Speakers who delivered addresses in addition to the toastmaster and Mr. Domhoff were James Bowron, president, Gulf States Steel Co., Birmingham, Ala.; John A. Penton, president, Penton Publishing Co., Cleveland, and W. M. Macon, *Iron Age*, New York.

Seek American Machinery

M. H. Dinshaw & Co., Bombay, India, machinery importers and commission agents, are desirous of representing American manufacturers of all kinds of machinery and equipment, including steam engines and boilers, molding and sand-blast machines, wood working machinery, metal working machinery, pumps, machine tools, etc.

The Lakewood Engineering Co., Cleveland, announces the establishment of a new office in Chicago located in the Lumber Exchange building. The Chicago office force consists of E. A. Allen, A. W. French, E. W. Cox and E. E. Zeiss.

An Easy Method for Determining Metal Mixtures

The Author Has Plotted Curves Whereby Cast Iron and Semisteel Mixtures May be Ascertained Readily and Without Resorting to Lengthy Calculations

By H L Campbell

THE success of many processes, to a large extent, depends upon the proper proportioning of raw materials. Cement clinker of commercial value could not be produced unless the available limestone and shale were mixed in the correct ratio. In the recovery of metals from their ores, it is necessary to use predetermined amounts of reducing and fluxing materials to react with the impurities which exist in the ores. It is well understood that the only safe way to produce reliable castings is to prepare the metal mixtures on the basis of chemical analysis.

To determine the relative quantities of raw materials to be used in any melting operation, it is necessary to know the desired analysis of the final product, the changes in composition which occur during melting and the chemical analyses of the materials available.

The physical properties of metals are closely related to their chemical composition Therefore, a chemical analysis may be prescribed for any purpose when the desired properties are known.

Change in Composition Constant

The change in composition of the metal mixture before and after melting will depend upon the method of melting, and for a given installation and a definite practice this change will be quite constant. In the cupola the silicon loss is about 0.25 per cent and the manganese loss is close to 0.15 per cent. Sulphur and phosphorus gain slightly, depending on the quality of fuel and the total loss of metal.

The contents of each car of pig iron are analyzed at the furnace, so it is possible for every foundry, large or small, to obtain the analysis of each lot of iron received. If it is desired, the analysis may be checked at the foundry laboratory.

Scrap iron and scrap steel may be sorted into various grades and the chemical analysis may be actually made or closely estimated on each lot. As a rule, the composition of the return foundry scrap is quite definitely known.

After deciding upon the most desirable chemical analysis for the castings in any practice, it will be necessary to determine the proportion of scrap to be used in the charges. The required analysis of the pig iron mixture may be calculated easily when the amount of scrap and its analysis is established.

In most cases it will be necessary to use two or more irons in order to produce the required chemical analysis in the pig mixture. The important influence of silicon content on the properties of metals has led to the practice of using this element as the determining factor in calculating metal mixtures.

Set of Curves Prepared

On account of the time required and the care necessary in working out metal mixtures for the foundry, this part of the daily program is badly neglected. For every definite practice a set of curves may be prepared from which the relative quantities of the different metals making up the mixture may be read directly.

On the chart, Fig. 1, are given the analyses of the proportions of the mix and the resulting metal. In this case the pig mixture must contain 2.10 per cent silicon. Using this figure as the basis, decreasing percentages of silicon are laid off on the base line toward the right. On the left side of the chart the scrap and pig are arranged in columns for every possible mixture. Each lot of high silicon pig is represented by a curve.

To find the correct mixture of any two cars of pig, which will produce the desired composition in the castings, a line is drawn vertically from a point on the base line which corresponds to the silicon in the low silicon pig, to the intersection of the curve which represents the percent silicon in the high silicon pig, and from this point of intersection a horizontal line is drawn to the left, which will indicate the proper weights of scrap, low pig and high pig for each charge.

If it is desired to use three or more lots of pig to a charge, the mix for any two lots must be found first and then any proportion of the different mixes may be added up to give the full charge.

As an example, suppose the scrap analyzes 1.70 per cent in silicon and there are two cars of pig on hand containing 1.80 per cent and 2.30 per cent silicon. From the chart, Fig. 1, we find that a full charge will consist of 1000 pounds of scrap, 400 pounds of low silicon (1.80 per cent) pig and 600 pounds of high silicon (2.30 per cent) pig. If in addition to the two cars of pig there is in the yard a small pile of 440 pounds of pig containing 2.14 per cent silicon, then the proper charge may be found as follows: It is shown on the chart that 120 pounds of low silicon (1.80 per cent) pig must be mixed with 880 pounds of high silicon (2.14 per cent) pig, or that one-half of this mix will use up all of the 2.14 per cent silicon pig. Therefore, one-half of this mix must be added to one-half of the mix from the two cars in order to give the total charge which will consist of 1000 pounds of scrap, 260 pounds of 1.80 per cent silicon pig from car, 300 pounds of 2.30 per cent silicon pig from car and 440 pounds of pig from yard.

In the preparation of similar charts it will first be necessary to determine the silicon content of the pig mixture, the total charge and the proportion of scrap to be used. When these values are established, the curve for each high silicon pig may be plotted.

Plotting the Curves

The following formula is used for plotting the curves:

m = pounds of pig iron in one charge.
x = pounds of low silicon pig in one charge.
$m - x$ = pounds of high silicon in one charge.
q = per cent silicon in low silicon pig.
r = per cent silicon in high silicon pig.
s = per cent silicon in pig mixture.

$$(q \times x) + [r \times (m - x)] = m \times s$$

$$\text{therefore, } x = \frac{m \times s - m \times r}{q - r}$$

By fixing m and s and keeping r constant for any curve, x may be found for different values of q. When the points are plotted on co-ordinate paper a set of curves similar to those in Fig. 1 will be produced.

The use of charts is especially recommended for small foundries where, as a rule, little attention is given to metal mixtures. When the melting practice has been established

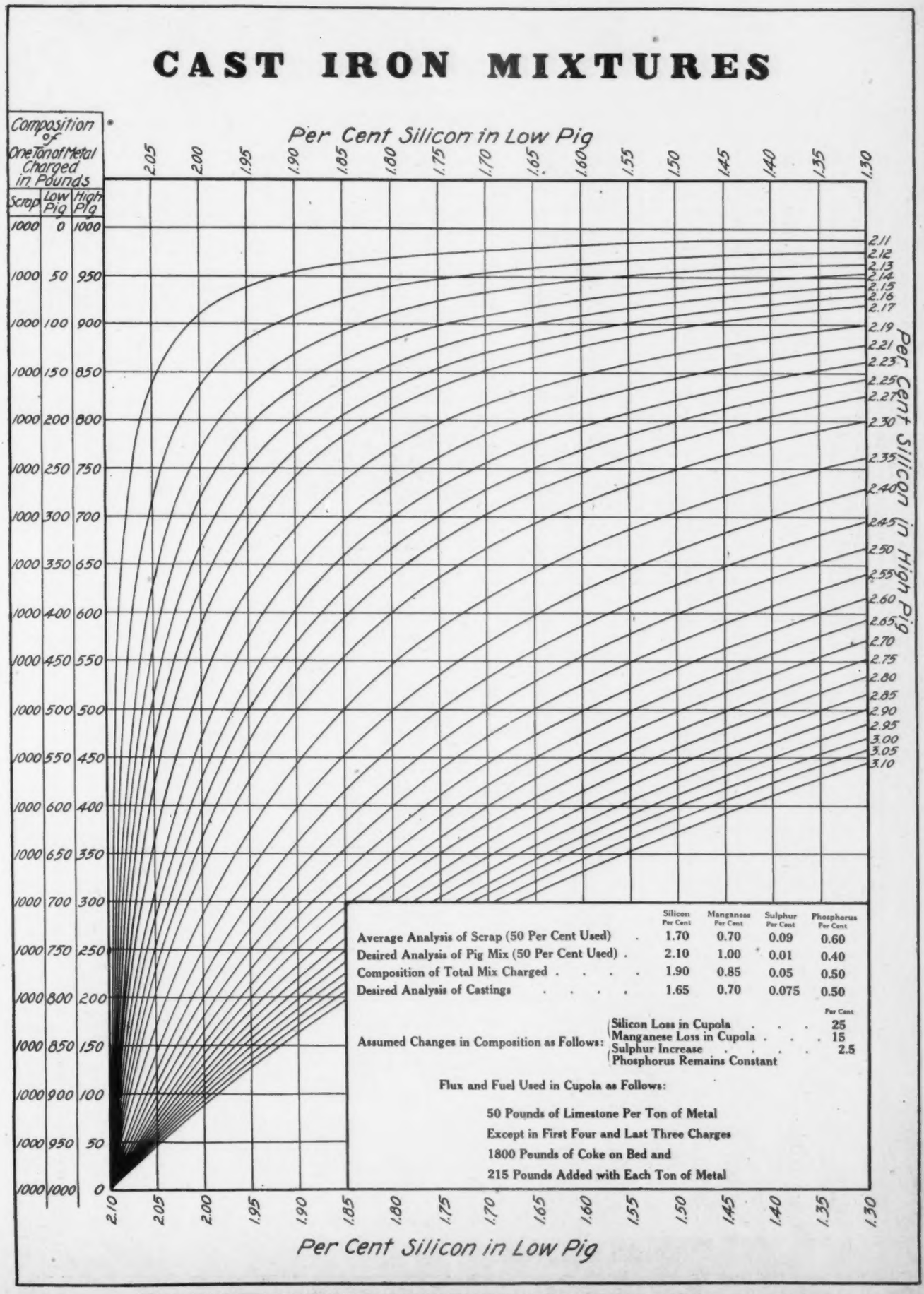
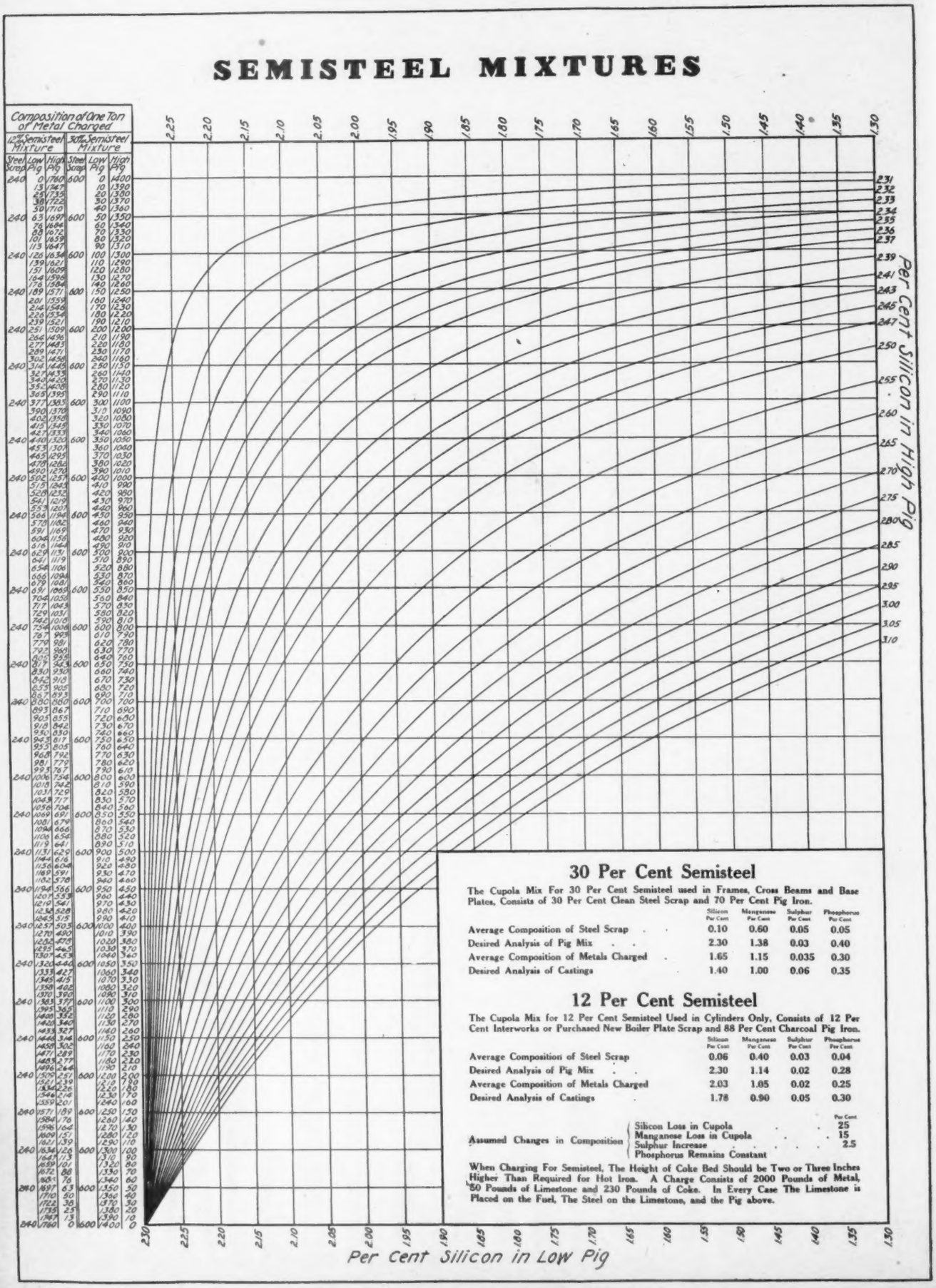

CAST IRON MIXTURES
Composition of One Ton of Metal Charged in Pounds
Scrap | Low Pig | High Pig
1000 0 1000
1000 50 950
1000 100 900
1000 150 850
1000 200 800
1000 250 750
1000 300 700
1000 350 650
1000 400 600
1000 450 550
1000 500 500
1000 550 450
1000 600 400
1000 650 350
1000 700 300
1000 750 250
1000 800 200
1000 850 150
1000 900 100
1000 950 50
1000 1000 0
Per Cent Silicon in Low Pig
2.05 2.00 1.95 1.90 1.85 1.80 1.75 1.70 1.65 1.60 1.55 1.50 1.45 1.40 1.35 1.30
Per Cent Silicon in High Pig
2.11 2.12 2.13 2.14 2.15 2.16 2.17 2.19 2.21 2.23 2.25 2.27 2.30 2.35 2.40 2.45 2.50 2.55 2.60 2.65 2.70 2.75 2.80 2.85 2.90 2.95 3.00 3.05 3.10
Per Cent Silicon in Low Pig
2.10 2.05 2.00 1.95 1.90 1.85 1.80 1.75 1.70 1.65 1.60 1.55 1.50 1.45 1.40 1.35 1.30
Silicon Per Cent | Manganese Per Cent | Sulphur Per Cent | Phosphorus Per Cent
Average Analysis of Scrap (50 Per Cent Used) . 1.70 0.70 0.09 0.60
Desired Analysis of Pig Mix (50 Per Cent Used) . 2.10 1.00 0.01 0.40
Composition of Total Mix Charged 1.90 0.85 0.05 0.50
Desired Analysis of Castings 1.65 0.70 0.075 0.50
Per Cent
Assumed Changes in Composition as Follows:
Silicon Loss in Cupola . . . 25
Manganese Loss in Cupola . . . 15
Sulphur Increase 2.5
Phosphorus Remains Constant
Flux and Fuel Used in Cupola as Follows:
50 Pounds of Limestone Per Ton of Metal
Except in First Four and Last Three Charges
1800 Pounds of Coke on Bed and
215 Pounds Added with Each Ton of Metal

FIG. 1—CHART GIVING THE ANALYSES OF THE PROPORTIONS OF THE MIXTURE AND THE RESULTING METAL

SEMISTEEL MIXTURES



30 Per Cent Semisteel

The Cupola Mix For 30 Per Cent Semisteel used in Frames, Cross Beams and Base Plates, Consists of 30 Per Cent Clean Steel Scrap and 70 Per Cent Pig Iron.

	Silicon Per Cent	Manganese Per Cent	Sulphur Per Cent	Phosphorus Per Cent
Average Composition of Steel Scrap	0.10	0.60	0.05	0.05
Desired Analysis of Pig Mix	2.30	1.38	0.03	0.40
Average Composition of Metals Charged	1.65	1.15	0.035	0.30
Desired Analysis of Castings	1.40	1.00	0.06	0.35

12 Per Cent Semisteel

The Cupola Mix for 12 Per Cent Semisteel Used in Cylinders Only, Consists of 12 Per Cent Interworks or Purchased New Boiler Plate Scrap and 88 Per Cent Charcoal Pig Iron.

	Silicon Per Cent	Manganese Per Cent	Sulphur Per Cent	Phosphorus Per Cent
Average Composition of Steel Scrap	0.06	0.40	0.03	0.04
Desired Analysis of Pig Mix	2.30	1.14	0.02	0.28
Average Composition of Metals Charged	2.03	1.05	0.02	0.25
Desired Analysis of Castings	1.78	0.90	0.05	0.30

Assumed Changes in Composition	Per Cent
Silicon Loss in Cupola	25
Manganese Loss in Cupola	15
Sulphur Increase	2.5
Phosphorus Remains Constant	

When Charging For Semisteel, The Height of Coke Bed Should be Two or Three Inches Higher Than Required for Hot Iron. A Charge Consists of 2000 Pounds of Metal, 250 Pounds of Limestone and 230 Pounds of Coke. In Every Case The Limestone is Placed on the Fuel, The Steel on the Limestone, and the Pig above.

FIG. 2—CHART FOR FIGURING SEMISTEEL MIXTURES

and a chart has been prepared all possible mixtures may be taken directly from the chart. Slight variations in the analysis of scrap will produce only small changes in the composition of the resulting metal. Foundries that do not have laboratory facilities may use the analysis made at the furnace of each car of pig iron received.

Charts may be prepared for semisteel mixtures and used to good advantage. Uniform results have been produced by using this method of determining the charges for semisteel. Fig. 2 shows a chart for semisteel mixtures which is in use at the Industrial Works, Bay City, Mich.

Uncle Sam—Storekeeper

To the Editor—

The greatest storekeeper in the world today is our Uncle Sam. For two or three years he has been purchasing supplies of all kinds for his millions of soldiers abroad and at home, on a scale so vast that the mere enumeration of his present stocks of manufactured articles alone surpasses comprehension, and the great problem to be solved by the war industries board and other government departments, now that demobilization is proceeding rapidly, is how to dispose of these vast accumulations with the least disturbance to the industries of the country and with the smallest loss to Uncle Sam himself.

During the continuance of the war, criticism of the apparent lack of organization of different departments, resulting in accumulation in some war department depots of unused and uncalled for goods and at the same time almost hysterical demands for similar articles at other depots, was unpatriotic, and it is only since the armistice that the extraordinary conditions are becoming generally known.

Not long ago a statement was made in a reputable journal that governmental investigation revealed in one supply depot, at Hampton, Va., no less than 150,000 dry batteries, 150,000 gallons of oil, 417 typewriters, 500 pairs of field glasses (which were at the time so scarce that people were being asked to donate their private glasses to the navy), 4,500,000 feet of ⅜-inch rope, besides several carloads of iron, steel and woodworking machinery.

The same report stated: "These items, however, are insignificant when compared with airplane motors, ordered by the French; motors and parts and planes ordered by us, which, according to estimate, run up to about $22,000,000. This includes parts for 3500 French Gnome airplane motors, valued at $10,500,000, which must now be sold as junk, there being about 2000 tons of these motor parts which vary from rough forgings to as high as 90 per cent completed."

If this accumulation were confined to a single supply depot, it would be trifling in amount, but there is, unfortunately, ample evidence that similar conditions exist elsewhere, resulting, it is said, in an oversupply of goods of nearly all kinds, even though the war had not suddenly ceased. Millions and millions of dollars worth of manufactured articles, clothing, shoes, foodstuffs, army trucks, metals and metal manufactures are now stored in supply depots, warehouses and wharves in this country and in Europe.

Some of these goods, in time, may be disposed of to civilians, but a very large proportion cannot be used in their present condition and, therefore, must be sold as junk.

The judicious disposal of the vast accumulation of goods of all kinds in such manner as to interfere as little as possible with the ordinary business of the country will be a problem of great intricacy and upon its solution will depend the even tenor of manufacturing business and trade for the next year or more.

ALEX. E. OUTERBRIDGE JR.

Publish Unique Booklet

"T' Other and Which" is the title of another novel and unique creation in the form of a house organ written and compiled by Frederic B. Stevens, Detroit, manufacturer of foundry and platers' equipment and supplies. Most of the articles contained in this booklet have a distinct human appeal and "America's Response," by A. H. Levy to Lieut. Col. John D. McCrae's gripping poem, "In Flander's Fields," measures up to the high poetic merit of the original. To give the work a business slant, a number of convincing and compelling collection letters that have given results, are included.

Foundry Equipment Manufacturers Effect Permanent Organization

The temporary organization of foundry equipment manufacturers effected at the Milwaukee convention of the American Foundrymen's association, Oct. 9, at the request of the war industries board to appoint a war service committee to represent the industry, at a meeting at Pittsburgh, Feb. 4, decided to continue the society in permanent form. It will be known as the Foundry Equipment Manufacturers' association and has an initial enrollment of 25 members.

The following constitute the board of directors: Verne E. Minich, Sand Mixing Machine Co., New York; James T. Lee, Vulcan Engineering Sales Co., Chicago; F. G. Smith, Cleveland Osborn Mfg. Co., Cleveland; R. H. Bourne, Whiting Foundry Equipment Co., Harvey, Ill., and Elmer E. Rich, Rich Foundry Equipment Co., Chicago. The officers are: Verne E. Minich, president; F. G. Smith, vice president, and A. O. Backert, Cleveland, secretary and treasurer.

Among the objects of the organization are the following: To foster better trade practices; to reform abuses existing or arising in the trade; to diffuse reliable and accurate trade information; to eliminate excessive costs due to unnecessary multiplicity of styles and types of equipment, and to lend full strength toward co-operating with other business associations with an idea of improving, strengthening and stabilizing the business interests of the country.

Membership in the association is held by the following companies: Champion Foundry & Machine Co., Chicago; Berkshire Mfg. Co., Cleveland; Dayton Molding & Machine Co., Dayton, O.; American Molding Machine Co., Terre Haute, Ind.; International Molding Machine Co., Chicago; Cleveland Osborn Mfg. Co., Cleveland; E. J. Woodison Co., Detroit; Arcade Mfg. Co., Freeport, Ill.; Vulcan Engineering Sales Co., Chicago; Grimes Molding Machine Co., Detroit; Buch Foundry Equipment Co., York, Pa.; U. S. Molding Machine Co., Cleveland; Sand Mixing Machine Co., New York; Rich Foundry Equipment Co., Chicago; New Haven Sand Blast Corp., New Haven, Conn.; Pangborn Corp., Hagerstown, Md.; J. W. Paxson Co., Philadelphia; McLeod Co., Cincinnati; Blystone Mfg. Co., Cambridge Springs, Pa.; National Engineering Co., Chicago; American Clay Machinery Co., Bucyrus, O.; Young Bros. Co., Detroit; Whiting Foundry Equipment Co., Harvey, Ill.; S. Obermayer Co., Chicago, and the P. H. & F. M. Roots Co., Connersville, Ind.

"The Lynchburg Foundry Company's Part in the War" is the title of a booklet issued by the Lynchburg Foundry Co., Lynchburg, Va., which details the amount of material which this plant delivered to the government, together with a statement regarding the purchase of Liberty bonds, war saving stamps, subscriptions to war service campaigns, etc. The company had 51 employes in the service of the United States army and navy in this country and abroad.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade

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Trade Outlook

READJUSTMENT from a war to a peace basis is being more keenly felt in the steel casting industry than in any other branch of the trade. This is due to the operation of these plants almost exclusively on government work for a period of more than a year and with the cessation of hostilities, cancellations practically wiped out their order books. Headway, however, is being made in the accumulation of tonnage, although this undoubtedly would be accelerated if further price reductions were made. Railroad buying of malleables is at a low ebb, but the motor car industry, in the last 30 days has been the source of considerable business for the malleable shops. Gray iron foundry business is best characterzied as spotty. Some specialty plants are melting to capacity, while others, particularly in the hardware and stove trades are on a minimum basis of operations. Although general iron and steel conditions are unsettled, buying is in better volume than at any time since the signing of the armistice and this foreshadows an early improvement in all branches of the foundry industry.

Acid Steel Gains Supremacy

WAR requirements and other government needs accelerated steel casting production to such an extent in 1917 that another high record was established. In 1916 the total output of the steel foundries of the United States was 1,371,763 tons and in 1917 production was increased to 1,441,407 tons, a gain of 69,644 tons. The total open-hearth furnace output was 1,213,156 tons, another high record and the reversal in the commanding position of basic to acid steel is noteworthy. This, of course, reflects the demands of the government for acid steel in preference to that made in a basic-lined furnace. The acid open-hearth output was 654,588 tons as compared with 558,568 tons, made in basic linings. Not since 1911 has the acid output exceeded the basic and the figures of this year, with the return of commercial demands, should prove of interest to all steel casting manufacturers. The open-hearth production in 1917 surpassed all previous records, although 1916 with 1,176,449 tons, set a new high record up to that time.

The production of steel by the bessemer or side-blow converter process also showed a large gain, having totaled 159,272 tons in 1917 as compared with 142,791 tons the previous year. Since 1913 the production of steel castings by the bessemer process has been doubled. The decline of steel castings by the crucible process from 9351 tons in 1916 to 3834 tons in 1917 must be attributed to the inability of foundrymen to obtain crucibles. It is only within a comparatively few months that a fair supply of pots for steel melting has been available. Electric furnace production jumped from 42,870 tons in 1916 to 64,911 tons in 1917. This increase of more than 50 per cent foreshadows what will be shown by the 1918 statistics in view of the tremendous increase in number of electric furnace installations last year. The production of alloy steel castings attained a total of 67,529 tons, which is an increase over 1916 of more than 11,000 tons, but shows a decline of more than 30,000 tons over the total of 1915. Due to the difficulty of obtaining reports on steel production for 1917, these figures have just been made available.

COMINGS AND GOINGS OF FOUNDRYMEN

H. N. Dispennette has been appointed purchasing agent of the Kalamazoo Stove Co., Kalamazoo, Mich.

Daniel W. Tower, president of the Grand Rapids Brass Co., Grand Rapids, Mich., and founder of the business in 1882, has retired from active business.

C. F. Battenfeld has been appointed Detroit representative of the U. S. Molding Machine Co., Cleveland, with headquarters at 12 Griswold street.

H. N. Curd, manager of the Lenoir Car Works, Lenoir City, Tenn., has resigned to accept a similar position with the Pacific Car & Foundry Co., operating plants at Seattle and Portland.

Lieut. William R. Moore, connected with the ordnance department since March 1, 1917, has resigned and has been made assistant sales engineer for the Norton Co., Worcester, Mass.

J. P. Williams was recently made sales manager of the Pratt & Letchworth Co., Buffalo, manufacturers of steel and malleable castings, succeeding G. P. Warner, resigned.

L. H. Thullen, who has been general manager of the Grand Rapids Brass Co., Grand Rapids, Mich., has been elected president of the company. J. Murray was made vice president and Carlton Austin, secretary and treasurer.

W. S. Quigley, president, Quigley Furnace Specialties Co., New York, sailed for Liverpool, Feb. 15. It is his intention to spend several weeks in England, France and Italy in the interests of the company's foreign connections.

Alden R. Ludlow, formerly vice president of the Liquid Carbonic Co., Chicago, has assumed his duties as second vice president and sales manager of the Air Reduction Co., New York.

C. J. Houck, formerly superintendent of the foundry operated by the King Sewing Machine Co., Buffalo, has accepted a similar position with the Clark Meter Co., Mattoon, Ill.

Lieut. Col. R. R. Lamont has resumed his duties as president of the American Steel Foundries, Chicago. During the war he was division chief of ordnance at Washington.

A. T. Jeffries, superintendent, and C. P. Osborne, manager of the Dayton Malleable Iron Co. plant at Ironton, O., have been transferred to the main office at Dayton, O.

A. J. McDonald, formerly purchasing agent for the Marlin-Rockwell interests, Philadelphia, has been made sales manager for the Lebanon Steel Foundry, Lebanon, Pa.

Carl Falk, eastern representative of the Davenport Machine & Foundry Co., Davenport, Iowa, manufacturer of molding machines, has established a branch office at 30 Euclid Arcade, Cleveland.

John F. Nealis, who recently received his discharge from the aero observers branch of the service, is now associated with the Powdered Coal Engineering & Equipment Co., Chicago, as advisory engineer.

Nathaniel Curry, who has been president of the Canadian Car & Foundry Co., Montreal, was made chairman of the board of directors at the company's recent annual meeting. He was succeeded as president by W. W. Butler.

Joseph N. Anderson Jr. has been elected a director of the Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, to serve the unexpired term of Maj. Joseph T. Speer, who died recently.

Theodore R. Hermanson, formerly affiliated with the Harrison works of the Worthington Machinery Corp., Harrison, N. J., has been appointed works manager of the Epping-Carpenter Pump Co., Pittsburgh.

William J. Reardon, formerly superintendent of the casting department of the Rome Locomotive & Machine works, Rome, N. Y., has become identified with the Detroit plant of the Aluminum Castings Co., Cleveland.

C. R. Messinger, vice president and general manager of the Chain Belt Co. and the Sivyer Steel Casting Co., Milwaukee, left for Europe early in February to supervise the re-establishment of export connections.

Frank S. Mills, foreman of the Palmer Foundry & Machine Co., Palmer, Mass., has leased the George A. Corser foundry, Ware, Mass., and will operate it in connection with a machine shop in the same city.

Raymond Hunter has been appointed manager of the recently established Boston office of White & Bro., Inc., Philadelphia, smelters and refiners. Mr. Hunter has represented White & Bro. in the New England district for a number of years.

Thomas S. Barter, chief engineer for the Norton Co., Worcester, Mass., has been transferred to special work for the engineering staff. He is succeeded by Thomas P. Webster, who for the past 12 years has been assistant chief engineer.

Huntley H. Gilbert has been made assistant sales manager in the western district for the Pressed Steel Car Co. and the Western Steel Car & Foundry Co., with offices in Chicago.

J. A. Ferris, who has been connected with the Whiting Foundry Equipment Co., Harvey, Ill., for the past 10 years in the design and sale of foundry equipment, now is affiliated with Scully, Jones & Co., Chicago, as sales engineer specializing on cranes.

Lester E. Armstrong has accepted a position as advisory engineer with the Powdered Coal Engineering & Equipment Co., Chicago. Prior to his service in the air branch of the army, Mr. Armstrong was associated with Babcock & Wilcox, New York.

I. D. Adams, formerly New York and New England representative of the Federal Foundry Supply Co., Cleveland, has assumed the position of New York and New England representative of the S. Obermayer Co., Chicago, with headquarters at Syracuse, N. Y.

C. Tack, formerly superintendent of the malleable iron foundry operated by the Oliver Chilled Plow Co., South Bend, Ind., has been appointed general superintendent of both the gray iron and malleable departments of this company, succeeding Mr. Antisdel, resigned.

William E. Fulton, for the past 18 years president of the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., has resigned. He is succeeded by his son, William Shirley Fulton, who has been treasurer and a director of the company.

Carl L. Liebau has purchased an interest in the Decatur Malleable Iron Co., Decatur, Ill. He recently disposed of his holdings in the Vermillion Malleable Iron Co., Hoopeston, Ill., to F. G. Moore of Cincinnati, who will assume charge of the plant.

Arthur F. Braid has been appointed sales manager of the metal and alloy department of the Metal & Thermit Corp., New York. He came to the company seven years ago as a traveling salesman and after a few years was made assistant superintendent of the Jersey City plant, in charge of the manufacture of alloys.

C. D. Townsend has been made general manager of the Ironton, O., plant of the Dayton Malleable Iron Co., Dayton, O. Mr. Townsend has for the past six years been general manager of the Danville Malleable Iron Co., Danville, Ill., which plant he built and equipped complete.

Maj. W. P. Putnam, connected with the ordnance department during the war, has returned to take up his duties as president and general manager of the

Detroit Testing Laboratory, Detroit.

Arthur N. Hook, foreman of the training department of the Norton Grinding Co., Worcester, Mass., has accepted a position with the Aluminum Castings Co. at its Detroit plant.

W. A. Buell, formerly conveyor engineer of the Goodyear Tire & Rubber Co., Akron, has been appointed sales engineer of the Barber-Greene Co., Aurora, Ill. H. W. Cudding has been appointed auditor of the company. He formerly held a similar position with the Lyon Metallic Mfg. Co.

Frank E. McIntyre, general superintendent of the National Steel Foundries, a subsidiary of the National Brake & Electric Co., Milwaukee, resigned Feb. 1 to become vice president and general manager of the Hercules Steel Casting Co., a new electric steel foundry of Milwaukee.

E. S. Carman, secretary and chief engineer of the Cleveland Osborn Mfg. Co., Cleveland, will said for Europe on March 6. While abroad he will make a survey of the foreign field in the interests of his company with a view of promoting the sale of molding machines in England and France.

D. J. Ryan, Allyne-Ryan Foundry Co., Cleveland, has purchased the Ecorse Foundry & Machine Co., Ecorse, Mich. The name of the foundry has been changed to the D. J. Ryan Foundry Co., and will be in charge of L. J. Feltes, formerly superintendent of the Allyne-Ryan foundry. Mr. Ryan will continue his business connections and residence in Cleveland.

Charles L. Newcomb, manager of the Dean Steam Pump Works of the Worthington Pump & Machinery Corp., Holyoke, Mass., and president of the New England Foundrymen's association, has been honored by selection as chairman of the committee which will organize a section of the American Society of Mechanical Engineers at Springfield, Mass.

Albert F. Fort has resigned as secretary of the Nichol-Straight Foundry Co., Chicago, and has been elected president of the Michigan City Foundry Co., Michigan City, Ind.

George W. Hite, for 10 years a salesman for the Pittsburgh Iron & Steel Foundries Co., Pittsburgh, and who relinquished that position Aug. 1, 1918, to enter the ordnance production division of the war department at Washington, has retired from the government's service. He recently contracted for 10 years with the Pittsburgh Steel Foundry Co., to manufacture a steel alloy which he has patented.

James A. Shepard, president, Shepard Electric Crane & Hoist Co., Montour Fall, N. Y., was elected vice president of the newly formed Material Handling Machinery Manufacturers' association at a recent meeting of the board of governors. The other officers chosen were Calvin Thompkins, formerly commissioner of docks for New York City, president, and Lucien P. Brown, Elwell Parker Electric Co., New York, treasurer. The organization has for its aim the mutual advancement of its members and particularly the improvement of freight handling conditions at railway and seaboard terminals.

John R. Foster, formerly with the

H. E. DILLER

Iron & Fuel Trading Co., Pittsburgh, has been appointed manager of sales of the ingot mold department of the Valley Mold & Iron Corp., Sharpsville, Pa., with offices in the Union Bank building, Cleveland. Ralph E. Velte, formerly with the Marshall Foundry Co., Pittsburgh, has been appointed manager of sales of the castings department of the company with offices in the Oliver building, Pittsburgh. J. W. Gault, formerly with the Browning Engineering Co., and Ernst & Ernst, accountants, Cleveland, has been appointed general auditor of the company. The appointment of Mr. Foster and Mr. Velte follow the recent absorption of the Valley Mold & Iron Corp. by the Marshall Foundry Co. The general offices of the company will remain at Sharpsville, Pa.

Victor T. Noonan has been appointed director of accident prevention for the United States Liability Insurance Co., in which capacity he will have charge of safety work in the various shipyard plants in Massachusetts, in Providence, and in Buffalo, N. Y. Mr. Noonan formerly was director of safety for the industrial commission of Ohio.

H. E. Diller

H. E. Diller, metallurgist and testing engineer of wide experience in the gray iron, steel and malleable iron branches of the foundry industry, is now affiliated with THE FOUNDRY in the capacity of associate editor. He recently resigned the position of chief of the testing laboratory of the General Electric Co., Erie, Pa., to undertake his new duties. Mr. Diller equipped himself for his career by a special course in metallurgy at the Pennsylvania State college and while he did not graduate, nevertheless, in 1912 the degree of M. S. was conferred upon him by this institution.

In 1897 he was employed as a chemist at the Homestead, Pa., plant of the Carnegie Steel Co. and two years later he was placed in charge of the chemical laboratory of the Orient Steel Co., Allegheny, Pa. Subsequently he was appointed chief of the chemical and physical testing laboratories of the Pennsylvania Malleable Co., McKees Rocks, Pa. He was in charge of the mixing, melting and annealing of the iron at this plant. After serving 1½ years with the Pennsylvania Malleable Co. he was invited to take charge of the joint chemical laboratory of the Brooks Locomotive works and the United States Radiator Co., Dunkirk, N. Y. After occupying this position for only a few months, he was appointed chief chemist of the Western Electric Co. He held this position for eight years, after which he was transferred to the research laboratory of the General Electric Co., Schenectady, N. Y. For 2½ years he worked in the electric furnace department, where carbon and high speed tool steel castings, ferrosilicon and other products were produced in different kinds of electric furnaces.

In 1912 he was in Europe for a considerable period, investigating and studying the practice of the gray iron, steel and malleable iron foundries of England, France and Germany. Upon his return from Europe he was transferred to the Erie works of the General Electric Co. and was placed in charge of the physical testing laboratory. As head of this department he constantly was in close touch with the company's gray iron and malleable foundries which constitute a part of this plant. He also had supervision over the heat-treating of steel at these works.

Mr. Diller has been unusually active in the affairs of the American Foundrymen's association and the American Society for Testing Materials. A number of years ago he was elected a director of the American Foundrymen's association, which office he still

holds and he also is chairman of the committee on standard specification for malleable iron of the American Society for Testing Materials.

Death of C. O. Olson

Charles O. Olson, superintendent of the foundry operated by the Johnston & Jennings Co., Cleveland, died in that city Wednesday, Jan. 22. On Jan. 10 Mr. Olson was injured by a fall, resulting in concussion of the brain and subsequent paralysis. He was a foundryman of wide experience and prior to his affiliation with the Johnston & Jennings Co. 15 years ago, he was the proprietor of a foundry and machine shop at Massillon, O. He was born July 2, 1864, at Stockholm, Sweden, and came to this country with his parents at the age of 13 years. He served his apprenticeship at Erie, Pa.

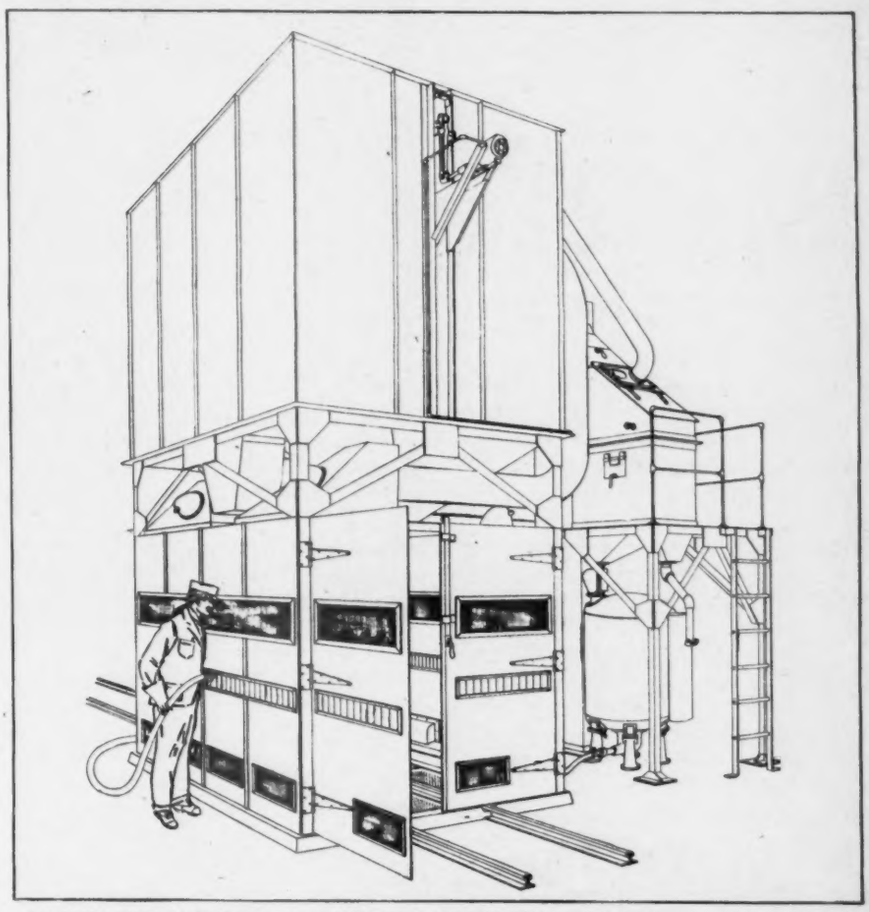
Death of Joseph Sillman

Joseph Sillman, president and founder of the Michigan Smelting and Refining Co., died Feb. 15, at his home in Detroit, following a brief illness from pneumonia. For the past decade Mr. Sillman was a prominent figure in the development of smelting and refining as adapted to nonferrous metals. He established the company of which he was the head, in 1900, and his abilities in the reclamation of waste materials and pioneer work in conservation led to his appointment during the war as a member of the committee directing the distribution and curbing of waste in nonferrous metals and alloys. In addition to the company of which he was president, Mr. Sillman was vice president of the Peninsular Brass Works, secretary-treasurer of the Thiery & Kendrick Mfg. Co., both of Detroit; and president of the Valley Smelting & Refining Co., Cleveland. He is survived by a widow and two sons, Norman and Cecil. Norman Sillman is associated in the business of his father.

Sand-Blast Room With Operator Stationed Outside

A sand-blast room for cleaning large castings, with the operator stationed outside, has been designed by the Pangborn Corp., Hagerstown, Md. This room has been termed the hygienic type, since it obviates the necessity of the operator to be in the room while directing the sand-blast onto the work.

As shown in the accompanying illustration, a nozzle slot extends around the four sides of the room at a convenient height. This is closed by multiple, sectional, flexible curtains through which the nozzle is inserted by the operator insuring freedom of movement in all directions. Above the nozzle slot at eye height, is a sight screen protected by a heavy woven wire cloth which prevents the escape of flying abrasive and affords an unobstructed view of the interior of the room and the work being cleaned. As will be noted in the accompanying illustration, the sand-blast machine, of the direct high-pressure type, is located outside of the room and is provided with a hose of sufficient length to permit the operator to reach every portion of the room.



SAND-BLASTING EQUIPMENT FOR HANDLING LARGE WORK WITH OPERATOR OUTSIDE OF THE SAND-BLAST ROOM

The room is constructed of ¼-inch steel plates supported by structural steel members. It is provided with a grated floor through which the spent abrasive, core sand, refuse, etc., pass to the conveyor or trough from which a sectional type screw conveyor delivers it to an elevator boot. This material then is elevated to a combined mechanical screen and exhaust separator where the fine dust, core sand and refuse material are separated and delivered to a refuse bin, piped for discharge to any convenient point. The clean, sharp abrasive for re-use is delivered to a storage bin connected to the sand-blast machine by a filling valve for automatically refilling the sand-blast machine. To conserve space, a platform is provided above the sand-blast machine, which supports the elevator, separator, motor and exhauster. Electric light fixtures, with white porcelain enameled reflectors equipped to protect the lamps from the abrasive, are distributed throughout the room.

The dust generated by the sand-blasting operation is drawn off through a ceiling hood and is passed to a dust arrester which is of the cloth screen type and is mounted above the room, being supported by the structural steel frame of the sand-blast room. The dust-laden air enters on one side, passes through a multiplicity of cloth screens which retain the dust and discharge it into hoppers. These can be piped to discharge their contents to any convenient point.

The accompanying illustration also shows air-inlet screens located around the base of the room to permit of the free ingress of fresh air. A heavy, closely woven wire screen cloth on the outside prevents the entrance of foreign particles while on the inside a hooded baffle prevents the escape of flying abrasive and dust without

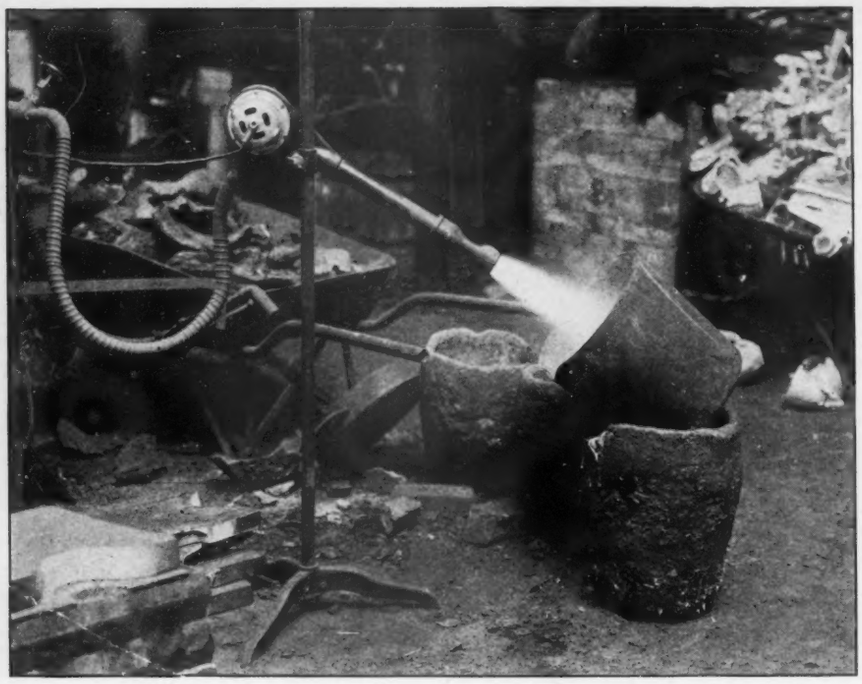


FIG. 1—PORTABLE GAS-ELECTRIC TORCHES MAY BE USED FOR LADLE AND CRUCIBLE HEATING, SKIN DRYING MOLDS AND PRE-HEATING FOR WELDING

retarding the entrance of the air. This room is equipped with an industrial track which extends through swinging doors at both ends for facilitating the routing of material. This type of room is adapted to the cleaning of large cored castings and can be constructed to conform in size and shape to the work so that the ventilation requirements may be reduced to the minimum. When cleaning long castings which extend beyond the capacity of the room, the end through which they project is protected by flexible curtains. In this way castings up to 20 and 30 feet long may be handled in a room from 10 to 15 feet long.

New Gas-Electric Torch Developed

Devised to fulfill the need for a portable high temperature blow torch, the unit shown in the accompanying illustrations has been developed to meet a wide range of uses. This apparatus, which is manufactured by the North American Mfg. Co., Cleveland, employs a simple method for producing the pressure and mixture necessary for high temperature combustion of gas or oil fuel. The device, in effect, is a mixing chamber, motor-driven fan, delivery pipe and nozzle. Flexible tubing supplies gas from the line, while a lamp socket connection and drop cord deliver current to the machine. A small electric motor fan draws air into the mixing chamber where it meets and is mixed with the gas. This mixture then is impelled by the fan through a delivery tube to a specially designed nozzle, where it may be ignited without preheating. It burns at a high temperature. The action in the apparatus is similar in effect to that secured in a bunsen burner, with the added velocity and volume of the mixture contributing a higher temperature to the flame.

Among the uses to which this torch is adapted are ladle heating, heating for forging, preheating for welding, skin-drying molds, heating rivets or small parts, applying heat to sections or pipes for bending, soldering and for removing insulation from electrical equipment. The flame supplied by the burner is over two feet long. A supplementary burner, which may be attached readily, supplies a smaller flame where a localized heating effect is desired.

The gas consumption for this torch is said to vary from 18 to 52 cubic feet per hour with artificial gas. A special burner is provided if it is desirable to use oil for fuel.

The company recently has developed a larger burner on the same general plan as that described. In this unit a motor fan unit is installed so that its impelling blades deliver directly to a supply line running to the torch. At one side of the fan is a central intake from the gas supply line. Opposite to this is the air intake with a diaphragm opening which may be rotated to control the air supply. A special nozzle is used which has an air regulating valve. The latter is employed if the supply of air is delivered from one fan to several nozzles, and it is desired to cut down the supply to any one of them. The blower delivers the mixture of gas and air at about 4.7 ounces pressure, but will operate up to one pound pressure. The gas consumption for this unit, it is said, is 550 cubic feet per hour for natural and 800 cubic feet per hour for artificial gas.

Special burners also are manufactured by this company for use with fuel oil. In effect, these are atomizers, supplied with air through the fan unit described previously. In this case the air is secured at both sides of the fan and forced through to the nozzle. A small, positive action, rotary pump driven by a motor, receiving power from a lamp socket is supplied to deliver the fuel oil under pressure. This pump is rated at 90 gallons per hour. Each of the oil burners described is designed to consume 3½ gallons of oil per hour.

The larger gas burner, and that for fuel oil, are designed for core or annealing oven work, and for long continued operation. The rush of air into the motor fan unit is devised to keep the motor cool for steady use in units of this class.

Opens Philadelphia Office

Reed, Fears & Miller, Inc., have opened a Philadelphia office for the sale of pig iron, coke, etc., at 514 Stock Exchange building. The new office will be under the supervision of J. C. Miller, president, who is also in charge of the DuBois, Pa., office. It will supplement the general office at Boston in charge of Charles A. Reed,

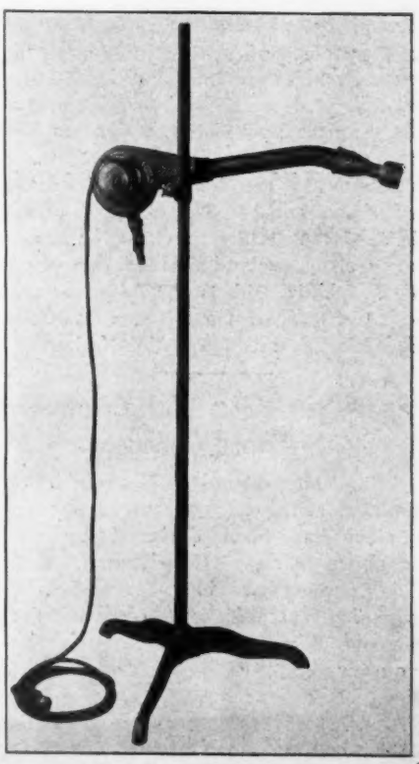


FIG. 2—GAS TORCH EQUIPPED WITH MOTOR-DRIVEN FAN FOR MIXING AIR AND GAS

treasurer, and the New York office which is managed by L. H. Miller, vice president.

Manufactures New Wax Fillet

A recent development of the wax fillet involves the use of a string which forms the center core. This core is added to give strength to the material when applied to the joints of patterns and it is claimed that when properly applied, this fillet is secure against rough handling, and when the pattern is old, the wax does not crack and chip off or drop from the corners. The wax which is formed into the proper shape for application to the joints may be feathered out by the use of a smoothing knife which is slightly heated. Shellac may be applied over the entire surface without a noticeable break at the line where the pattern surfaces joint the edge of the fillet. The material is supplied in 2-foot lengths packed in cartons which contain 100 feet each. These strips are triangular in section with the string core at the apex and the edges tapering to either side.

The wax that is used is combined to give a high melting point, greater than that attained in ordinary room temperatures. The materal was developed by the Shaw & Washburn Mfg. Co., Cleveland, and is supplied through E. J. Woodison Co., Detroit.

Issues Circular on Wood

"Woods Used in Patternmaking" is the title of a 16-page circular issued by the Thomas E. Coale Lumber Co., Philadelphia. This contains a reprint of an article by E. F. Lake, which appeared in THE FOUNDRY in October, 1913, and discusses various woods used for making patterns.

The F. H. Wheeler Mfg. Co., manufacturer of protective wearing apparel, has removed its plant and offices to 215 West Huron street, Chicago.

The Sterling Wheelbarrow Co., Milwaukee, has established an office at Boston in charge of R. F. Jordon.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Wenatchee Iron Works, Wenatchee, Wash., is erecting a foundry, 50 x 120 feet.

Hutchinson Bros. & Co., 409 Bay street, Victoria, B. C,. plan the erection of a foundry.

Part of the plant of the Meech Foundry Co., 10221 Meech avenue, Cleveland, recently was damaged by fire.

The Magnus Co., Inc., 241 Greenfield avenue, Milwaukee, contemplates erecting an addition.

P. J. McNey, Temple, Tex., plans the erection of a foundry.

The Liberty Foundry & Mfg. Co., Plymouth, Mich., recently was incorporated with $25,000 capital.

The Briak Blast Mfg. Co., Monroe, Mich., contemplates erecting a foundry.

The Watson-Frye Co., Bath, Me., will take bids shortly for the erection of a foundry.

The foundry of the Willsea Works, 60 Brown's place, Rochester, N. Y., recently was damaged by fire.

The Central Foundry Co., Saginaw, Mich., contemplates the erection of a foundry.

An explosion recently damaged the plant of the Hull Iron & Steel Foundries, Ltd., Hull, Que.

The St. Maurice Foundry Co., Three Rivers, Que., recently started work on the erection of an addition.

The plant of the Pottsville Foundry & Stove Co., Pottsville, Pa., recently was damaged by fire.

The Hancock Foundry & Machine Works, Hancock, Md., contemplates the erection of a foundry addition.

The core department of the National Radiator Co., Johnstown, Pa., recently was damaged by fire.

The Portage Iron Works, Portage, Wis., plans the erection of a foundry and other improvements.

The McKinney Steel Co., 4002 Dille avenue, Cleveland, is erecting a foundry addition, 52 x 167 feet.

The A. Garrison Foundry Co., South Ninth and Bingham streets, Pittsburgh, has applied for a permit to erect a foundry addition.

Architect S. J. Bowler, 322 South Fourth street, Minneapolis, has plans prepared for the erection of a foundry. The name of the owner is withheld.

The Valley Mould & Iron Corp. with plants at Sharpsville, Pa. and West Middlesex, Pa., has purchased the Marshall Foundry Co. plant in Pittsburgh.

The Tri-State Foundry & Machine Co., Wellsburg, W. Va., has obtained a site at Warren, O., on which it plans to erect a foundry and machine shop.

The Charles Bohn Foundry Co., 738 Hart avenue, Detroit, is having plans drawn for the erection of a foundry 168 x 240 feet.

The Astoria Marine Iron Works, Astoria, Oreg., has purchased four miles of water front, and plans to erect a plant which will include a foundry, machine shop and fabricating plant.

The Anchor Co., Washburn, Wis., plans the erection of a shipbuilding plant, to include a foundry, 55 x 270 feet and other metalworking departments.

The Manganese Steel Castings Co., Norfolk, Va., will start work soon on the erection of a plant, 30 x 60 feet.

The Anderson Barngrover Mfg. Co., San Jose, Cal., plans to build an addition to include a foundry and pattern shop.

The Pan Motor Co., St. Cloud, Minn., contemplates the erection of a foundry, 130 x 180 feet. George Books is engineer.

The powerhouse at the plant of the American Car & Foundry Co., 2800 DeKalb avenue, St. Louis, recently was damaged by fire.

The Nickel Plate Foundry Co., Cleveland, recently was incorporated with $100,000 capital, by J. H. Hollander and others.

The LaPorte Foundry & Furnace Co., LaPorte, Ind., has issued $50,000 of capital stock, making its total capitalization $100,000.

The Wilson Foundry & Machine Co., Pontiac, Mich., recently purchased the equipment of the Monroe Motor Co.

Work has started on the erection of an addition, 36 x 85 feet, to the plant of the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.

The French Mfg. Co., 135 Jackson street, Newark, N. J., has leased property from the Universal Castor & Foundry Co. for the manufacture of castings.

The American Sub-Soil Plow Co., Winston-Salem, N. C., contemplates the erection of a foundry. S. E. Case is general manager.

The Vulcan Iron Works, Wilkes Barre, Pa., contemplates the erection of a foundry at Buttonwood, Pennsylvania.

It is reported that the Nebraska Foundry & Mfg. Co., Omaha, Nebr., contemplates erecting a branch plant at Fremont, Nebr.

An iron foundry is to be erected at Nampa, Idaho, by J. B. Mant, Portland, Oreg., according to A. W. Hoy, of the Nampa Commercial club.

The Defiance Machine Works, Defiance, O., will equip its plant with new machinery and will erect a new foundry.

The Marion Foundry Corp., Marion, Ind., has been incorporated with $30,000 capital, by Ora E. Butz, Fred W. Case, L. Leroy Close and George L. Colt.

The Norman Foundry Co., Brooklyn, N. Y., recently was incorporated with $15,000 capital, by J. and H. Miller and B. Zwerin, 856 Griggs avenue.

The Lincoln Stove Repair Co., 203 South Tenth street, Havelock, Nebr., contemplates the erection of a foundry.

The Waterloo Gasolene Engine Co., Waterloo, Iowa, has awarded a contract for the erection of a foundry, 150 x 600 feet.

The Oltmer Iron Works, 700 Monroe street, Jersey City, N. J., has awarded a contract for the erection of a foundry, 100 x 160 feet.

The Hansen & Olson Co., Chicago, recently was incorporated with $25,000 capital to operate a foundry and works for the refining of metals.

The Otto Biefeld Co., 202 North Water street, Watertown, Wis., is taking bids for the erection of a foundry.

The Henry Miller Foundry Co., 825 Long avenue, Cleveland, will take bids soon for the erection of a branch plant at Medina, O.

The Essex Foundry, Avenue D and Murray street, Newark, N. J., plans the erection of an office building addition.

The Malleable Iron Fittings Co., Branford, Conn., is erecting a steel foundry, 20 x 135 feet. V. T. Hammer is in charge of construction.

The foundry of the Sivyer Steel Casting Co., Thirty-seventh avenue, Milwaukee, recently was damaged by fire.

The Studebaker Corp. of America, South Bend, Ind., is building a new plant, consisting of a machine shop, assembling plant, foundry and tool room.

The Levis Foundry Co., Commercial street, Levis, Que., is in the market for machinery for its new addition.

The Abram Cox Stove Co., American and Dauphin streets, Philadelphia, recently awarded a contract to Henry E. Baton, 1713 Samson avenue, for alterations to its foundry.

The Griffin Wheel Co., 40 Gerrish avenue, Chelsea, Mass., has let a contract for a plant, which will include a foundry, machine shop, core room, cleaning room, etc.

The Michigan City Foundry & Machine Co., Michigan City, Ind., has been incorporated with a capital of $50,000, by Walter K. Greenbaum, L. N. Kramer and Edward A. Simpson.

It is reported that a company is seeking to obtain property at Washington Courthouse, O., on which to erect a foundry. The property is owned by the Sanderson Cyclone Drill Co., Orville, O.

The Weyler Brass Foundry Corp., New York, re-

cently was incorporated with $10,000 capital, by A. Lashareff, H. Weyler and V. Crasnoff, 205 West Eighty-fifth street.

The Azadian Instrument Corp., Syracuse, N. Y., has been incorporated to operate a foundry and machine shop, with $25,000 capital, by V. Metzger, K. R. Standrell and H. B. Azadian.

The Colonial Foundry Co., Louisville, Ky., has been incorporated with $65,000 capital, by Clarence M. Converse, C. A. Jackson, Russel J. Burt, John C. Welty and Harry Connor.

The Special Bolt Machinery Corp., New York, has been incorporated to operate a foundry and machine shop, by W. H. Foster, S. Robertson, 588 Seventy-fifth street, Brooklyn and others.

The Anderson Foundry & Machine Works, Anderson, Ind., will place $500,000 of preferred stock on the market, and expansion of its business is being planned.

Thomas Pink Co., Ltd., Pembroke, Ont., has been incorporated to operate as founder, blacksmith and machinist, with $200,000 capital, by Thomas Pink, Edward A. Dunlop and William L. Hunter.

The core room annex of the Allyne-Ryan Foundry Co., Aetna road and East Ninety-first street, Cleveland, recently was damaged by fire. A temporary structure is to be erected.

The American Cast Iron Pipe Co., Birmingham, Ala., recently has taken over the plant of the Beggs Pipe & Foundry Co. of the same city for the manufacture of special shapes.

The Eastern Metal Products Co., Portland, Me., has been incorporated to conduct a general foundry, machine shop and manufacturing business, with $25,000 capital.

Thomas E. Monks, president of the Cleveland National Bank, Cleveland, has purchased the controlling interest in the Carroll Foundry & Machine Co., Bucyrus, O.

Articles of incorporation have been filed by the Whitmore Machine & Foundry Co., Oshkosh, Wis., with $100,000 capital, by L. W. Whitmore, Bennett Plowright and and Peter Verwey.

The Taylor-Wilson Mfg. Co., McKees Rocks, Pa., has awarded a contract for the erection of a foundry 90 x 190 feet, to replace the plant recently damaged by fire.

The Auto Specialties Mfg. Co., St. Joseph, Mich., recently let contracts for the erection of plant extensions, including a foundry, 100 x 176 feet, and an annealing room.

The Union Machine Co., Louisville, Ky., has been chartered with $15,000 capital, to conduct a brass foundry, etc., by Ray Buckley, Harry Buckley and M. L. Kannapel.

The American Blower Co., Detroit, contemplates the erection of a new foundry on a site recently acquired in that city. J. A. Moore is superintendent of the foundry and W. E. Mettler, purchasing agent.

The Thomas Railway Track Appliance Co., Kansas City, Kans., of which J. W. Thomas is president, recently has added a gray iron, semisteel, brass, bronze and aluminum foundry and a pattern shop to its facilities.

The Wilmington Casting Co., manufacturer of light gray iron castings, Wilmington, O., is having plans prepared for a fire-proof pattern storage vault and will be in the market for such equipment as steel shelving, steel lockers, etc.

The Burlington Brass Works, Burlington, Wis., is reported to be planning construction of a new plant, which will include a brass foundry. Architect H. Sierks, 108 North Dearborn street, Chicago, is preparing tentative sketches.

Bradsto Appliances, Inc., Buffalo, has been incorporated with $50,000 capital, to manufacture auto accessories, castings, etc., by H. E. Bradford, Buckingham hotel; J. H. Weir, 939 Lafayette avenue and G. W. Farrar, 232 Voorhees avenue, Buffalo.

Anderson & Mathison recently were incorporated and plan to open a foundry at Norfolk, O. The officers of the company are, Anton N. Anderson, president; Bernard Mathison, vice president and Louis Ehrenworth, secretary.

The Union Press Co., Boston, has been incorporated to operate a foundry and machine shop with $100,000 capital, by Alfred H. Hildreth, Winchester, Mass.; Ira L. Fish and Arthur P. Stone, Belmont, Mass.

The iron foundry of the Liberty Foundry Co., Inc., 7600 Reilly avenue, St. Louis, recently was damaged by fire.

C. B. Westerberg & Co., New York, has been incorporated with $50,000 capital to manufacture machine tools and to operate a foundry. The incorporators are C. H. Westerberg and C. Westerberg, Westfield, N. J., and E. Goehrig, 101 West Eighty-fifth street.

The Victor Foundry Co., East Peoria, Ill., recently organized, has purchased the plant of the Oelkers-Pfaindler Foundry Co. which will be enlarged. The officers of the new company are D. Myeer, president; George F. Meyer, vice president; and George Harms, secretary.

The Ruddy Furnace Co., Dowagiac, Mich., contemplates building an extension to its foundry, 50 x 200 feet in size. This will provide additional molding floor space for 50 molders. A. E. Rudolph is president of the company and R. S. McNaney superintendent of the plant.

The Port Arthur Shipbuilding Co., Ltd., Port Arthur, Can., is building an extension to its foundry, 40 x 90 feet. This is the second addition that has been made during the past five years and the foundry now is 160 x 90 feet in size. Castings weighing up to 15 tons are poured and in addition this company builds all of the engines for the ships constructed on its ways.

The Long & Allstatter Co., Hamilton, O., manufacturer of power punches and shears, is erecting a gray iron foundry, 90 x 370 feet, which will include also a raw material and flask and casting storage yard. The foundry will be commanded by six traveling cranes, with capacities of from 5 to 30 tons and the metal will be melted in three cupolas, to be installed by the Whiting Foundry Equipment Co., Harvey, Ill.

NEW TRADE PUBLICATIONS

FURNACES AND OVENS.—A wide variety of core and mold-drying ovens, annealing, heating and melting furnaces are described and illustrated in a 32-page booklet issued by Holcroft & Co., Detroit. Steel foundry open-hearths, from five to 20 tons capacity, are shown, both in gas-fired and oil-fired types. Larger furnaces for steel plant usage, also are built by this company. One five-ton installation is shown in which the heated air is drawn from a hood over the brick work and is utilized for heating the building in the winter. Annealing furnaces built by this company cover a wide range of sizes. One type illustrated is provided with a furnace car to which is attached a brick-work door. Malleable and crucible furnaces of various types are described, and finally a variety of mold and core-drying ovens.

THREAD-CUTTING MACHINERY.—The Webster & Perks Tool Co., Springfield, O., has prepared, in loose-leaf form, a complete pamphlet of its line of pointing, thread-cutting and special tapping machinery. The automatic die thread-cutting machines shown are designed for large capacity production and are recommended for threading set and cap screws, studs, rods and similar work. These are illustrated in single and multiple spindle units. Special reversing type thread-cutting and tapping machines with adjustable stops to reverse at a predetermined point, at twice the forward cutting speed, are shown. These also are built in single or multiple spindle units. A five-spindle, vertical nut tapping machine and special holding devices developed by the company are fully described and illustrated.

POWDERED COAL.—The Quigley Furnace Specialties Co., New York, in a recently issued bulletin, describes the transportation and burning of powdered coal. In the installations which are illustrated, the powdered fuel is fed by gravity from a bin at the pulverizing plant into blowing tanks. These tanks are mounted on automatic scales which indicate the amount of fuel available for transport. Air is admitted to the blowing tanks from a compressed air receiver and the fuel flows through a pipe line to bins located at each furnace or group of furnaces. Control valves in the line direct this flow as desired. Furnaces using this fuel are illustrated in the bulletin. These include rod and billet heating and steam hammer furnaces.

HAULAGE SYSTEMS.—Flat wheel haulage systems, developed by the Lakewood Engineering Co., Cleveland, are illustrated and described in a 24-page bulletin. This haulage equipment includes storage battery tractors for hauling trains of trailers, storage battery trucks for carrying deck loads not to be used with trailers and trailers and hand trucks. The service views of these trailers are interesting and reflect the wide adaptability of this haulage equipment. It may be used to advantage in practically all industrial operations.

STOKERS.—Stokers for industrial furnaces, designed and built by the Combustion Engineering Corp., New York, are illustrated and described in a bulletin recently issued. These stokers have been designed for furnaces such as are used in sheet mills and forging plants; annealing furnaces in steel foundries, forging plants and wherever steel is given heat-treatment; for open and pot annealing furnaces and for furnaces adapted to the rapid production of special shapes, such as turnbuckles, car wheels, ash bars, eye bolts, nuts, rivets, etc.

ELECTRIC TRAVELING CRANES.—A profusely illustrated, 28-page catalog devoted to cranes and crane installations, has been issued by the Milwaukee Electric Crane & Mfg. Co., Milwaukee. In addition to service views illustrating various uses for this conveying equipment, a number of improvements in crane construction also are described. The company's extensive manufacturing facilities are illustrated by numerous interior views of various departments of its plant.

CLAM SHELL BUCKETS.—The line of clam shell buckets manufactured by the Lakewood Engineering Co., Cleveland, is comprehensively illustrated and described in a 24-page bulletin. A number of interesting service views are included, as well as general data regarding sizes, capacity, details of construction, dimensions, etc. Two pages also are devoted to the extensive line of industrial haulage equipment built by this company.

LOCOMOTIVE CRANES.—In a 96-page, profusely-illustrated catalog, the Brown Hoisting Machinery Co., Cleveland, treats exhaustively its extensive line of locomotive cranes. The many uses of these cranes are graphically shown by operating views. Some of these uses include loose material handling, heavy excavating work; handling of castings, structural material, heavy sheets, plates, etc.; manipulating pile drives or shovel dippers; shunting cars about the storage yard and terminal hoisting and unloading. The mechanical features are treated in detail and are fully illustrated. Dock installations, among which is the one at the port at Cherbourg, France, are shown. Special wharf-type cranes spanning four railroad tracks were installed by this company in American terminals in France to aid in handling miscellaneous materials for the army. These also are described. The extensive use of locomotive cranes in shipbuilding is indicated by a number of illustrations, and numerous foreign installations throughout the world are included. The catalog is one of the most complete issued, covering the entire field of locomotive cranes.